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ON THE COVER

SURVEYORS for the U. S. Bureau of Reclamation emulated mountain goats last summer while investigating the feasibility of building a dam in Hells Canyon on the Snake River between Idaho and Oregon. The situation shown on our front cover was not staged, it was routine. More about the field work and the proposed dam will be found in the article that starts on page 42.

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IN THIS ISSUE

THE story of York Corporation (page 30) is pretty much the story of modern refrigeration. York has been producing equipment for making and keeping things cold since the early days of the industry. Excepting household refrigerators, it builds just about every type of machine used for this purpose, including a complete line of air conditioners. The range extends from off-the-shelf fractional horsepower units to king-size machines that are individually engineered to meet specific needs. All are turned out in factories that utilize the most modern methods and equipment to cut time and costs. Pneumatic tools of many types are indispensable aids at various points in the operations.

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THE average person probably doesn't think of plastics as being an engineering material. Yet Synthane Corporation, a concern that is big enough to advertise in general magazines of national circulation, makes plastics well-nigh solely for industrial purposes. They are of the laminated variety, representing a union of some sort of fiber with resins, bonded by heat and pressure. They possess the strength and toughness to resist impact and abrasion and also have desirable anticorrosion and dielectric properties. Their field of service ranges from table tops to bearings for rock crushers, and from bobbins for textile mills to vanes for rotary compressors. Compressed air figures importantly in the production of Synthane. Page 38.

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TO BE of maximum utility, a portable air compressor must be really portable. In trying to meet the demand for larger and larger machines of this type, manufacturers ran smack into the problem of keeping them highly mobile. The solution found by Ingersoll-Rand Company is a compressor of entirely new design. The Gyro-Flow 600, which is introduced on page 44, combines a rotary compressor and a dependable diesel-engine driver in a unit that conserves weight and at the same time offers advantages not found in conventional reciprocating-type portables that have monopolized the field heretofore.

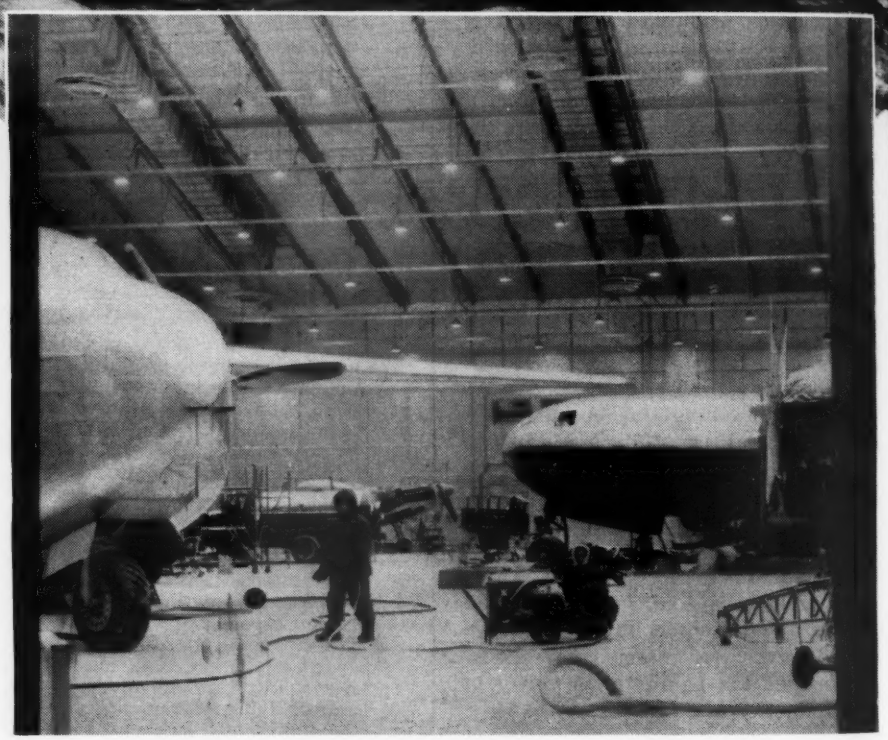
Cooling Things Off and Keeping Them Cool is the Business of

York Corporation

C. H. Vivian

ROOM AIR CONDITIONER
This packaged ¾-hp. unit, with a hermetically sealed refrigeration circuit, rests on a window sill and plugs into an electrical outlet like a radio. At the turn of a knob it will cool, dehumidify, and circulate the room air, or provide circulation without cooling.

AN OLD adage to the contrary, changing horses in midstream (metaphorically speaking, of course) hasn't worked out badly for York Corporation, of York, Pa. York has been a leading name in the refrigeration field for so long that probably few persons know it started out in a different one. Actually, in its 86 years of existence it has varied its products more than once to keep abreast of a continually shifting economy. Even in the past two decades it has, while holding its traditional position as a leader in the building of heavy refrigeration machinery, established itself firmly in the newer related field of air conditioning. York-produced equipment now in service ranges all the way from a 24,000-hp. industrial cooling plant to ½-hp. units for conditioning the atmosphere of single rooms. In short, the concern has survived and grown by developing a facility for adapting its resources and skills to meet the needs of a progressive world.



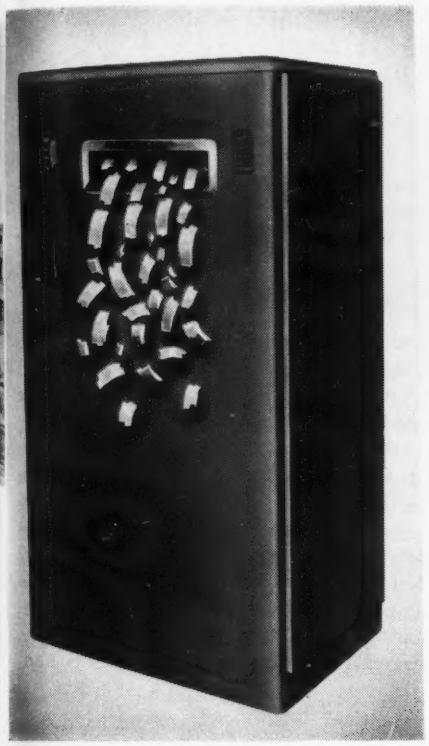
CLIMATE TO ORDER
At Eglin Field, Florida, the Air Force maintains a 3,000,000-cubic-foot all-weather test chamber for airplanes. In this $10,000,000 hangar, the temperature may be varied at will through a range from minus 70 to plus 165°F. Three York compound turbocompressor refrigeration systems, aggregating 6750 hp., produce the cold.

For ten years after it started out in 1874 as the York Manufacturing Company the concern built steam engines, agricultural and papermaking machinery, and water wheels. Mention of the last-named product recalls, incidentally, that one of the original directors, Stephen Morgan Smith, withdrew in 1880 and organized his own firm for manufacturing water wheels on which he held some patents. Today, as the S. Morgan Smith Company, the concern is among the foremost producers of hydraulic turbines. Its factory is just across some railroad tracks from one of the York plants.

York built its first refrigeration machine in 1885, but continued to subsist on its established lines for some years afterward. In fact, the management many times doubted whether it had been wise in embarking upon the new venture. It must be remembered, of course, that me-

S. S. "UNITED STATES"

The largest air-conditioning system so far installed aboard ship will provide comfort cooling on the liner "United States" (left), $67,000,000 luxury craft that is scheduled to go into service some time next year. York turbocompressors will produce the refrigeration to cool the water to be utilized. Of greater size than any vessel previously built in America, it will accommodate 2000 passengers and can be readily converted into a troopship with a carrying capacity of 12,000.



ICE MAKERS

York makes two types of machines for producing ice in handy, usable form. The FlakIce unit, left, delivers thin, curved flakes that are frozen as a sheet on a revolving stainless-steel cylinder and then scraped off and broken to uniform size. Capacity of the various models ranges from 2000 to 7400 pounds a day. The ice flakes are used in restaurants, hotels, dairies, hospitals, etc. The Yorkube machine, above, makes up to 8000 hollow cubes of ice (450 pounds) a day. Tubular sections are frozen inside pipes and then cut to size. The cubes cool beverages quicker than solid ones because of their greater surface area and are chiefly in demand for that purpose. By turning a dial, the unit also produces crushed ice.

chanical refrigeration was then in its infancy and virtually unknown to the general public. Natural ice, harvested and stored in winter, took care of such meager cooling as was done, and few persons thought there was a profitable future in machines that made ice. A brief digression here into the painfully slow development of cooling processes until comparatively recent years will perhaps help present the situation in a better perspective.

In the warmer regions of the earth, at least, the benefits of refrigeration were for many centuries enjoyed only by royalty. While campaigning against the Persians, Alexander the Great had his wines chilled with snow. Similarly, Numidian slaves carried snow from the Alps for cooling the food and drinks served at Nero's banquets. By the time of Charlemagne (742-814) the storage and use of ice had become fairly common.

The discovery in 1550 by an Italian, Vlasius Villafranca, that temperature could be reduced by dissolving saltpeter in water marked the beginning of scientific efforts to produce cold artificially. Using snow and saltpeter, Tancredus attained still lower temperatures in 1607, and from then on this "frigerific" principle was extensively applied. Until recent years, mixtures of rock salt and ice were commonly utilized in making ice cream and holding it in frozen condition while it was transported. When Fahrenheit, in 1724, immersed a slender tube of mercury in a mixture of salt and snow, he thought he was recording the lowest temperature artificially attainable and consequently marked the point as zero on his thermometer.

An Englishman, Dr. William Cullen, is credited with having devised a purely mechanical apparatus for producing ice around 1775, but few details about it are known. The first patent on an ice-making device was granted to Vallance in France in 1824. Dry air passed over water in shallow pans picked up the rising vapors and induced an evaporative effect that gradually cooled the water until it froze. During each cycle the moisture-bearing air was run through sulphuric acid to dry it for reuse. This marked the first conception of a continuous freezing process. The principle upon which it is based is utilized in cooling water carried in canteens and the canvas bags of desert travelers.

The compression system that is now widely employed for refrigeration was introduced in 1834 by Jacob Perkins. Ether that flowed into a cylindrical vessel containing tubes was vaporized by partially evacuating the space with a cylinder-and-piston pump. On its return stroke, the piston compressed the ether vapor, which was then liquefied by cooling it with water and thus prepared for recycling. Faraday, in London, developed a similar process with ammonia as the refrigerant. In 1850, Professor Twinning, of New Haven, Conn., devised apparatus akin to Perkins's and likewise depended upon ether as the refrigerant. His combination vacuum and compression pump had a cylinder diameter of 8½ inches and a piston stroke of 18 inches, and the latter reciprocated 180 times a minute.

Twinning cooled a low-freezing-point liquid and circulated it around open iron molds to freeze the water in them, thus inaugurating the brine principle that has been widely used since then. He also discovered that ice produced by means of temperatures considerably below the freezing point of water would be cloudy, whereas temperatures close to the freezing point would yield ice that was clear except for a small porous core in the center. Twinning is generally considered the father of the compression-refrigeration system in this country. Following his announcements, several concerns began the manufacture of ice-producing equipment.

Meanwhile, the utilization of air as a refrigerant had brief popularity but did not survive as a commercial process because it proved to be too costly. Dr. John Gorrie, of Apalachicola, Fla., developed the first equipment by which this could be done and obtained a patent on it in 1851. Knowing that air takes up heat upon being compressed and gives it up when allowed to expand, he reasoned that by cooling compressed air before expanding it he could obtain freezing temperatures. This worked, but when the laws relating to thermodynamics became more clearly defined, it was apparent that it was more economical to use a volatile liquid such as ammonia. Thereupon numerous inventors, whose efforts were centered upon air systems, shifted to the more favorable refrigerants.

In the interim, however, compressed-air refrigeration had its day. An outstanding example was the Popp centralized compressor plant in Paris that was put in service in 1868 and grew to 10,000 hp. in 1892. Piped to homes and

COMPACT COMFORT COOLER

Occupying a floor space of only 23x32 inches and standing less than 7 feet high, the Model 352 floor-type Yorkaire conditioner, above, will keep a fair-size store or restaurant comfortable during even the hottest weather. Recirculated air enters grilles in the lower part, and outside air also may be introduced there through suitable connections. Cooled, dehumidified air issues from grilles at the top that have adjustable vanes to direct it as desired. The compact interior assembly is illustrated at the top-right. At the bottom are the hermetically sealed compressor, with its 3-hp. driving motor, and the condenser for the Freon-22 refrigerant that is used. The compressed and liquefied Freon vaporizes in the central section, producing cold that is transferred to the air stream as it flows through a nest of finned tubes. The latter are assembled in two banks forming a "V," and the air stream is normally divided between the two segments. However, by means of a control device, called the "atmostat," it can all be directed through one bank. When humidity is excessive, this permits an increase in moisture extraction without cooling the air beyond the comfort point. In the upper section of the unit is a fan for discharging the conditioned air.

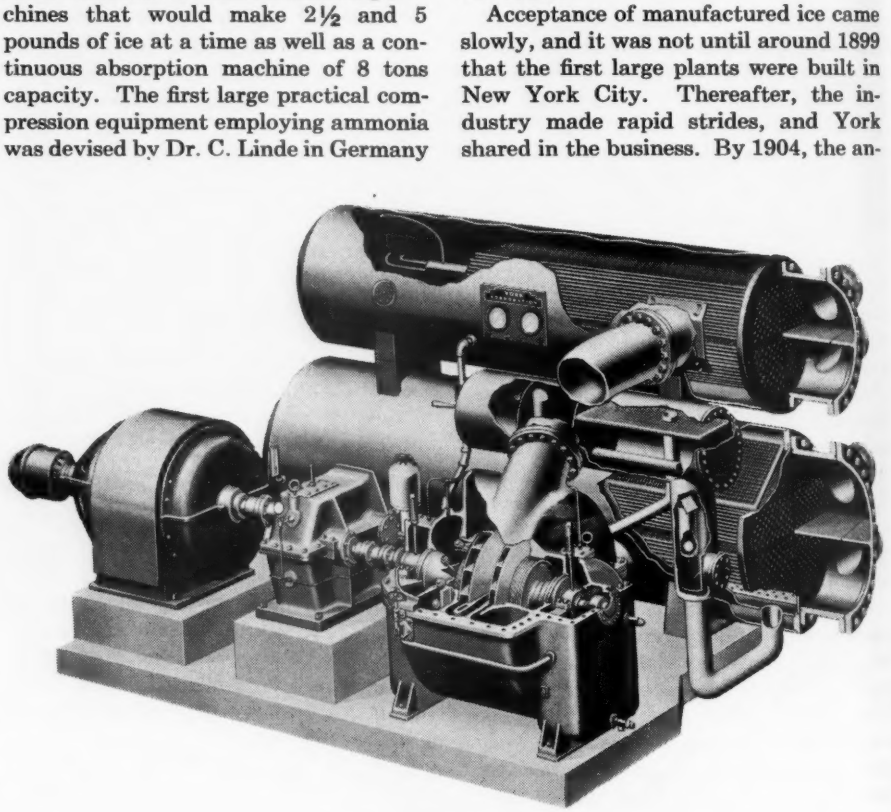
to shops primarily for operating machinery, large volumes of air were also expanded to cool refrigerators in households, beer gardens, etc. This system was likewise utilized to a considerable extent for cooling cargoes aboard ships, and it is recorded that substantially all the beef and butter shipped from Australia and New Zealand to London between 1872 and 1890 were carried in vessels equipped with compressed-air machines.

A small machine for partially freezing water in the carafes or bottles that were then the vogue in France was exhibited at the Paris Exposition in 1867 by Edmund Carré. At the same time, Ferdinand Carré showed small alternating machines that would make 2½ and 5 pounds of ice at a time as well as a continuous absorption machine of 8 tons capacity. The first large practical compression equipment employing ammonia was devised by Dr. C. Linde in Germany in 1873, and in 1887 he erected a 100-ton plant in England.

This was the general status of the art when York entered the field. The company sold its first refrigerating machine, with a daily ice-making capacity of 1½ tons, in Mississippi, and its success soon brought orders for several 5-ton units. Refrigeration continued to be only a small part of the firm's business, though, for users of natural ice were loathe to change. When P. H. Glatfelter, a successful paper manufacturer of Spring Grove, Pa., bought the York assets in 1889, he considered dropping the new line and might have done so had not the following winter been unusually warm.

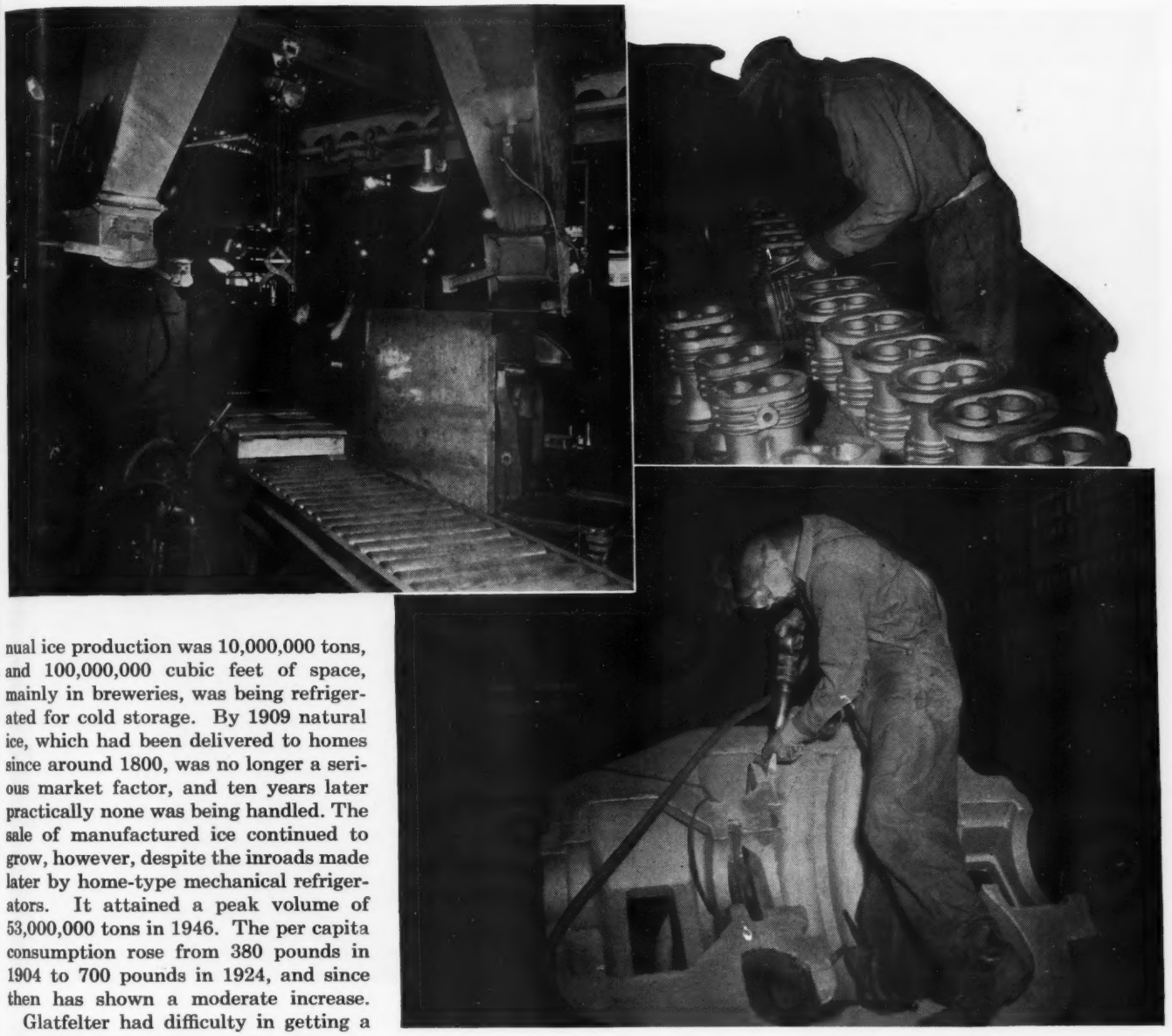
To turn out equipment to alleviate the resultant ice shortage, York put on night shifts. However, the natural-ice famine lasted only a year, and it was not long before Glatfelter had to put money into the business rather frequently to keep it going. Most of the machines produced went into ice-making plants, but cold storage was beginning to flourish and units ranging in capacity from 15 to 150 tons of refrigeration were furnished to meat packers, breweries, and other establishments. Also, strange as it may seem, two large installations for freezing the surface of skating rinks were made in the 1890's.

Acceptance of manufactured ice came slowly, and it was not until around 1899 that the first large plants were built in New York City. Thereafter, the industry made rapid strides, and York shared in the business. By 1904, the an-



CUTAWAY VIEW OF TURBOCOMPRESSOR REFRIGERATION UNIT

The refrigerant, in a gaseous state, is compressed by centrifugal action of the impellers in the foregound, then passes to the top vessel where water flowing through finned tubes condenses it into a liquid. The latter passes through the intercooler (small cylinder between the two bigger ones) where it is cooled to the interstage temperature of the compressor. It then flows into the cooler (large lower vessel) where its evaporation extracts heat from the water, brine, or other liquid circulating through the finned tubes. The now gaseous refrigerant is returned to the compressor to begin another cycle.



FOUNDRY OPERATIONS

Pneumatic tools save time and effort in cleaning castings in the foundry. The lower picture shows an intent workman using a Size 200 chipping hammer on half a casing for a centrifugal compressor. A small Multi-vane grinder that turns at 17,000 rpm., upper-right, easily gets into small spaces in a casting for a reciprocating-compressor cylinder. Trolley-mounted Air-bloc hoists (upper-left) relieve human muscles in handling cores and flasks in the preparation of molds for the casting line.

nual ice production was 10,000,000 tons, and 100,000,000 cubic feet of space, mainly in breweries, was being refrigerated for cold storage. By 1909 natural ice, which had been delivered to homes since around 1800, was no longer a serious market factor, and ten years later practically none was being handled. The sale of manufactured ice continued to grow, however, despite the inroads made later by home-type mechanical refrigerators. It attained a peak volume of 53,000,000 tons in 1946. The per capita consumption rose from 380 pounds in 1904 to 700 pounds in 1924, and since then has shown a moderate increase.

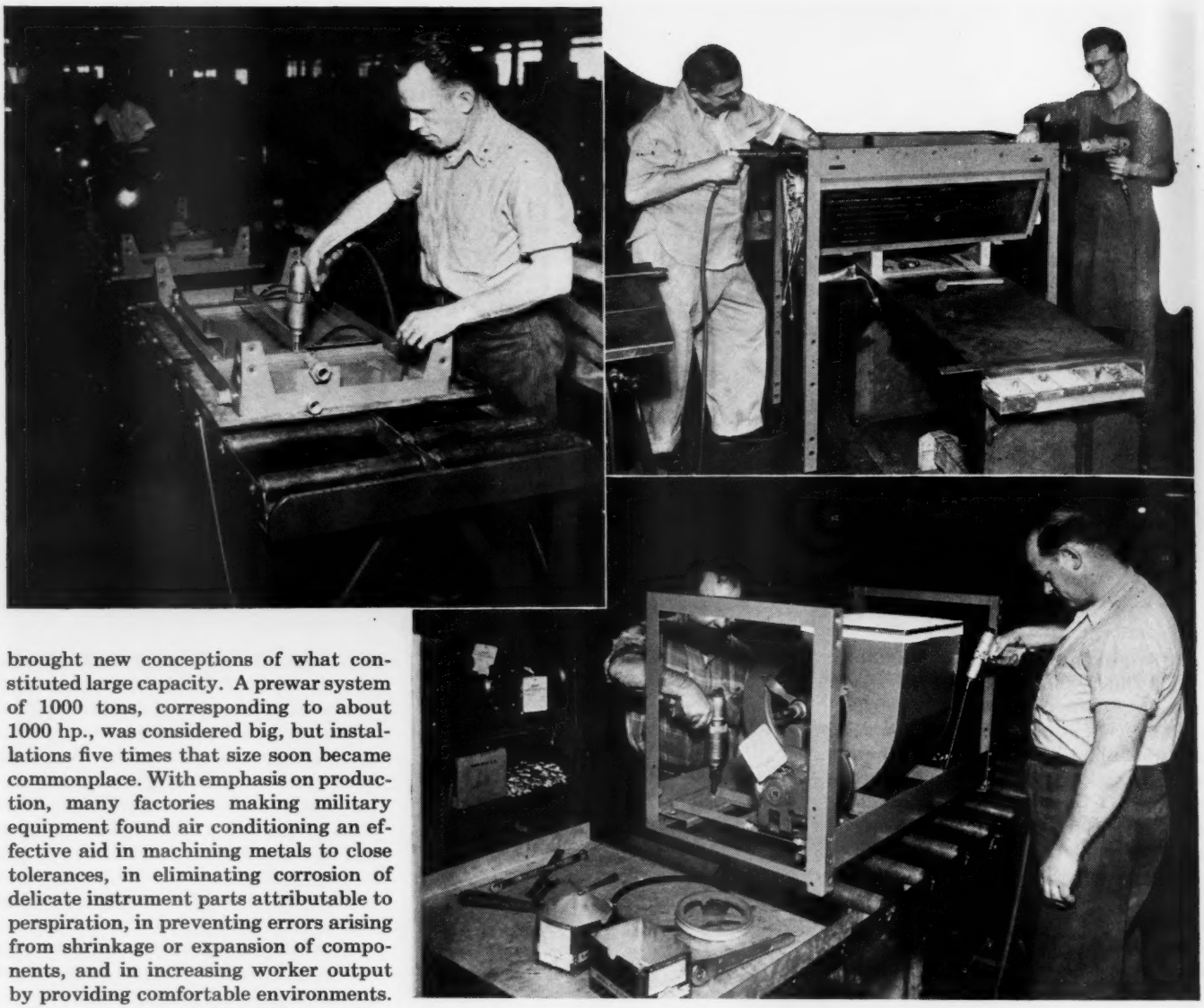
Glatfelter had difficulty in getting a manager who could cope with the problems of the new industry, but he had faith in its future and built a machine shop, a boiler shop, and a foundry in 1893. The right man to direct the activities came along in 1897 in the person of Thomas Shipley, who joined the organization as general manager and became a vice-president in a few years. Although young, he was experienced in the refrigeration field. His first move was to redesign the machinery to improve its efficiency, and his second was to drop the manufacture of all extraneous products. In electing to concentrate on equipment for the refrigeration field, he explained: "You can succeed in any line if you are an expert, but if you are only a dabbler, you'll be brushed aside."

York management has adhered rather closely to the policy laid down by Shipley. It has kept itself expert through continual engineering development and research and has confined its efforts to interrelated products. It prides itself that its factories are equipped with the most up-to-date machinery and tools and operated in accordance with the most advanced ideas of manufacturing efficiency.

Largest of all the York-built plants is the one for chilling water to assist the Columbia River in dissipating the heat from the chain-reacting pile of radioactive material in the Hanford Works of the Atomic Energy Commission near Richland, Wash. There, three refrigeration systems, with an aggregate capacity of 24,264 tons divided among ten units and driven by 20,000 hp., cool water to three different low temperatures. Unadvertised during the war period, this installation won for York Corporation in 1946 the annual award presented by *Chemical & Metallurgical Engineering* for the most outstanding engineering achievement.

It was natural that York should enter the air-conditioning field. Its first experience in that branch goes back almost to the beginning of the century and involved equipment for dehumidifying blast-furnace air. Later it supplied machinery for controlling the atmosphere in textile mills to improve spinning and weaving operations. Since then it has broadened the applications of its mechanical cooling plants, and its total installed capacity for commercial purposes now exceeds that of any other manufacturer. As in the case of ice-making and cold-storage equipment, the machines are individually engineered or tailored to fit the conditions they serve.

World War II sharply increased the demand for industrial cooling plants and



YORKAIRE ASSEMBLY LINE

Air-operated tools play an indispensable part in putting together packaged air-conditioning units on assembly lines. These pictures show three of the many steps in building up subassemblies for a Yorkaire 5-hp. cooler that is similar in general appearance to the unit illustrated on page 30. The operator in the view at the upper-left is at the first station running ½-inch nuts on bolts with a Size 504 impact wrench to form the cabinet base. The two workers at the upper-right are putting a V-type evaporator assembly in place. The man at the left is using a Multi-vane screw driver and the one at the right a Size 508 impact wrench. The other illustration shows a fan assembly being mounted. The man at the left is applying cap screws with a Size 504 impact wrench while his companion, equipped with a smaller tool of the same kind fitted with an extension, is running ½-inch nuts on bolts in a hard-to-get-at location.

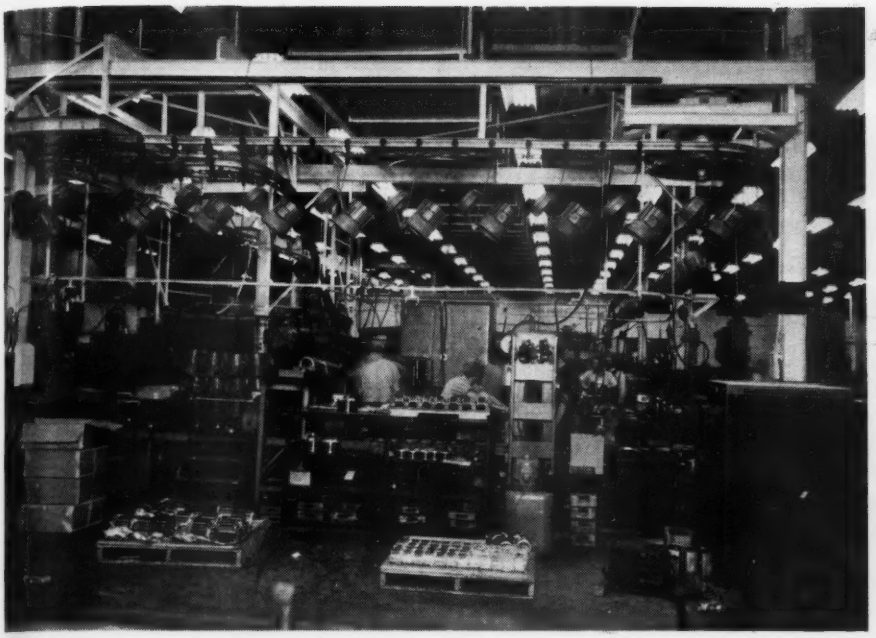
brought new conceptions of what constituted large capacity. A prewar system of 1000 tons, corresponding to about 1000 hp., was considered big, but installations five times that size soon became commonplace. With emphasis on production, many factories making military equipment found air conditioning an effective aid in machining metals to close tolerances, in eliminating corrosion of delicate instrument parts attributable to perspiration, in preventing errors arising from shrinkage or expansion of components, and in increasing worker output by providing comfortable environments.

The great growth in comfort cooling began in the 1930's, and equipment for this purpose is now an important part of York's production. Apparatus large and small condition the atmosphere in nearly every conceivable type of structure in which people assemble. Retail stores long ago learned that comfortable surroundings invite patronage, and York records show that this is applicable even to places of worship. The First Baptist Church of Richmond, Va., installed York equipment in 1941 and now draws as large a congregation in July as in January. Increased collections have justified the expenditure. More than 100 F. W. Woolworth stores in different sections of the country have been conditioned since 1935 under an arrangement that makes York responsible for servicing the plants.

York designs and builds not only large equipment for central cooling systems but also a complete line of packaged conditioners for offices and homes. In 1950, alone, it introduced six new sizes ranging from ½ to 5 hp. each. Their outstanding feature is a hermetically sealed refrigeration unit. The refrigerant can't leak out or dirt get in. York guarantees them service free for five years. Smallest room coolers (½-1 hp.) fit on window sills. Intermediate sizes (1½-2 hp.) are of the console type which, with the aid of ducts, may be made to serve additional rooms. Large units (3-5 hp.) are of the cabinet type. Some of the smaller single-room coolers are marketed by the Philco Corporation and bear its name.

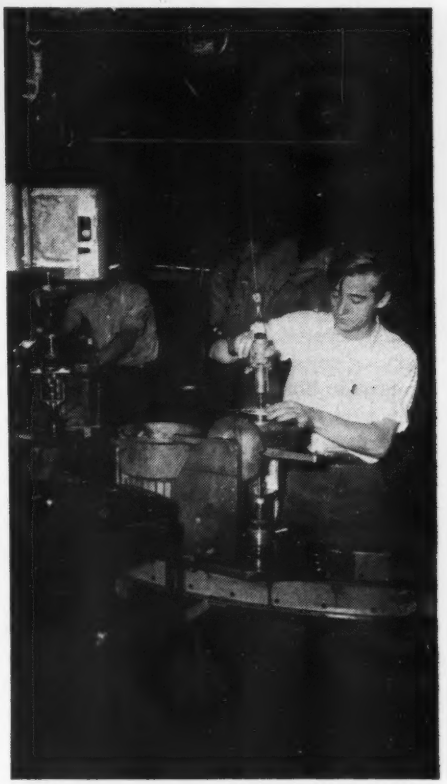
Although York doesn't manufacture mechanical refrigerators for households, it does produce two relatively small ice-making machines that have special applications. The effectiveness of ice as a cooling agent can be improved by increasing its exposed area, and for this reason, as well as for convenience in using, it has long been crushed for certain purposes. The maximum area can be obtained by producing ice in the form of flakes or wafers, and this is done by freezing it on a revolving stainless-steel cylinder and then scraping it off. The York FlakIce machine makes up to a ton of ice ribbons a day with 2 hp. and is also provided in larger sizes. Among the many users of such ice are fishing boats, shippers and packers of fruits and vegetables, florists, etc.

The home mechanical refrigerator popularized ice cubes, but it does not produce them fast enough for most commercial needs. Hollow cubes, tradenamed Yorkubes, which cool drinks



ASSEMBLING HERMETICALLY SEALED CONDITIONER UNITS

In a new building, equipped to use every square foot of space to greatest advantage, small compressor parts are machined and assembled and the finished machines with their motor drivers are then placed in airtight cases that are incorporated in air-conditioning units. Pictured at the left are overhead conveyors that deliver cases to the workers. The other view shows one station on the assembly line where most of the operations are performed with the aid of pneumatic tools. The workman is using a Size 502 impact wrench with a pistol grip to apply a retaining cap screw.



quicker than solid ones because of their greater surface area, are turned out by a compact cabinet apparatus introduced by York in 1948. Its sealed-in refrigeration system, driven by a ¾-hp. motor, makes up to 450 pounds (8000 cubes) a day, depending upon the temperature of the inlet water. Water sprayed down hollow tubes around which a refrigerant is circulated freezes from the outside in. When the hole reaches a certain size, the refrigeration cycle is reversed, and the tubes are warmed enough to free the columns of ice. As they drop, steel fingers or picks cut them into cubes. If crushed ice is wanted, the turn of a dial provides it. York also manufactures frozen-food cabinets of varying sizes, as well as special cooling equipment for the dairy industry.

Until around 1930 ammonia predominated as the refrigerant although, to meet Navy specifications during World War I, York developed enclosed compressors that used carbon dioxide. Between 1925 and 1930 such machines were also furnished for the comfort air-conditioning systems that were occasionally installed. The advent of Freon-12, first of a group of related halogenated hydrocarbons discovered in 1930 by Thomas Midgley, signalized the serious entrance of York into this new field. Possessing suitable thermal properties and being nontoxic and nonflammable, the Freons quickly became popular as refrigerants in cooling public places.

York's early applications of Freon-12 included the air conditioning of railroad passenger cars, among them those of the Baltimore & Ohio's "Columbian"—the first train in regular service to be completely conditioned. A decision to utilize the new refrigerant also for the cooling of large enclosures was made when bids were asked in 1931 for air conditioning the U. S. Senate Office Building in Washington, D. C. When government engineers refused to consider the York bid on the grounds that Freon-12 had not been accepted commercially, S. E. Lauer, then York's sales manager and now its president, pressed the matter until it was aired before a Senate investigating committee.

Engineers from York and du Pont, which manufactures Freon, presented an intensive educational course on the properties of the compound, and in the end the contract went to York, but with the provision that Freon-12 would have to meet certain guarantees relating to power requirements per ton of refrigeration. A year later, when the completed system was tested, it was found to operate with 13 percent less power than had been stipulated. Thereafter, Freon-12 and the other Freon formulations that followed came into general use for both large and small air-conditioning installations.

A compressor is the heart of a refrigeration system, and this type of machine has undergone many changes since York entered the field. At the outset the company adopted a vertical, single-acting compressor and successfully sold it in many heated battles against the competition of double-acting units. In those early days, steam-engine compressor drive was universal, and it was the practice to condense the steam to provide distilled water for making ice. That was true also where ice was manufactured by the absorption system, which was then a rival of the vapor-compression system.

By about 1913 the cost of electricity had become low enough to compete with steam, and it had already been demonstrated that it was not necessary to use distilled water to make ice of acceptable purity. Because motor-driven compressors possessed certain advantages over steam-powered ones—such as savings in space, cleanliness, and greater convenience—the trend turned in their favor. At about the same time the compression system, whether served by steam or electric drive, began to eliminate the absorption system on the basis of efficiency and economy. With the ascendancy of raw-water ice and electric drive, many ice-making plants switched to motorized compressors or to a more efficient type of steam engine than they had been using, and York participated in this business. That conversion also influenced the development of enclosed-crankcase compressors of large sizes similar to the smaller units York had been building for some time.

In the late 1930's, York engineers introduced an entirely new compressor design, known as the V/W because outwardly the different sizes resemble those letters. By combining veed cylinders in groups of four, machines ranging from 4 to 16 cylinders and from 15 to 275 hp. can be obtained. By largely standardiz-

RING ASSEMBLY LINE

Hermetically sealed refrigeration circuits of the larger sizes are assembled on an oval-shaped line of which one end is pictured at the left. Pneumatic tools are visible at several points hanging from overhead balancers which help to support their weight while they are in use and serve to hold them up out of the way at other times. The partial assembly at the left, with a fixture attached to facilitate the operations, is supported by a chain extending from a 300-pound-capacity Air-bloc hoist mounted on an overhead trolley. The workman shown below is near the end of the line and is using an angle-type nut-running tool to which is attached a flat gear box for applying cap screws.

ing on one cylinder size, most parts can be made interchangeable among units of varying capacities, with attendant economies for both manufacturer and user. This type is extremely compact, requires little floor space and, because it is balanced to reduce vibration, can be placed on upper floors of structures without special foundations.

The latest York compressor is a large-capacity centrifugal model that was introduced in 1940 to meet the need of machines to serve the air-conditioning systems put into war-production plants and laboratories. It is built in nine sizes ranging up to 1600 hp., and with up to four stages of compression. Various members of the Freon family of refrigerants are used, depending upon the temperatures to be obtained. In the aircraft test room at Wright Field, Dayton, Ohio, Freon-12 is chilled to minus 130°F. Among the advantages of the centrifugal are that it can be driven by a synchronous motor, with a resulting favorable power factor; its high efficiency even at partial loads; and the ease with which its capacity can be automatically controlled.

In 1893, when P. H. Glatfelter demonstrated his confidence in the future of the refrigeration industry by erecting new buildings, he also chose a new location. Those structures, with additions made since that time, have grown into what is known as the West York plant. By 1907 the site was fully occupied and pretty well surrounded by the growing city and the company had to go farther afield to expand its manufacturing activities. In that year it established the nucleus of the present Grantley plant on what was then farming land well outside the community's limits.

Today, the two factories provide the equivalent of fourteen city blocks of floor space, all of which is intensively utilized. A foundry at Grantley serves both plants, which give employment to approximately 4800 persons. Besides, means for turning out miscellaneous equipment needed in making large installations are available at some of the eight district sales offices in this country. In London, where York products are handled by a subsidiary concern—York Shipley Limited—there are extensive manufacturing facilities.

Keeping continual watch over manufacturing procedures is the industrial engineering department, which has gradually evolved from a shop-betterment program initiated in 1928. Before any new work is launched, the department analyzes it to determine the most efficient layout arrangement and recommends the equipment and tools for it. Estimates of operating costs are submitted to the cost accountants and top management for approval. Preparatory to steady production, the department carries out the operation on a trial-lot basis, makes time studies, and sets the bonus rates to be paid regular workers. It then assigns one of its men to it as a trouble shooter to further improve methods and reduce costs. Similarly, the department sanctions all changes in established operations such as rearrangement of equipment and writes the specifications for all new machines and tools. In addition, it regularly trades men with the various production departments for mutual training, and every general foreman has thus become familiar with its objectives and procedure. It also handles all tool rooms and tool-design work, and 40 of its personnel of 65 are identified with these activities.

Under the guidance of the industrial engineering department, York recently adopted the Methods-Time Measurement System for setting work standards and methods. M. T. M., as it is known, is an outgrowth of time studies made some twenty years ago at Westinghouse Electric Corporation by Gustav J. Stegemerten and Harold Maynard. Since then the two men, assisted in recent years by Jack Schwab, have patiently developed and extensively tested the system, which they sell through their firm, Methods Engineering Council, of Pittsburgh, Pa.

Briefly, M. T. M. is a procedure that analyzes any manual operation or method into the basic motions required to perform it and assigns to each motion a predetermined time standard that is based on the nature of the motion and the conditions under which it is made. It is a technique for setting time standards without the use of a stop watch. This is accomplished by observing the motions of an operator; breaking the

motions down into moves, reaches, grasps, and the like; measuring the distance of the moves and reaches; and applying to them time values from the M. T. M. data cards that are furnished. The experience of 50-odd companies that are using the system indicates that it is simpler, more accurate, more widely applicable, and about four times faster than are conventional time-and-motion studies.

Results of the careful planning of shop arrangement, equipment, and practices by the industrial engineering staff are visible throughout the plants. Naturally they are most in evidence wherever units are turned out in sufficient volume to permit dividing the operations involved into a great number of small tasks, each performed in the most effective and quickest way and the whole dovetailing into a smooth-running sequence.

In this category are the lines where air-conditioning units are assembled. The most outstanding example, however, is a new department where the hermetically sealed refrigeration circuits that go into some of these conditioners are put together. There, in one large room, that is maintained under slight air pressure to keep out dust, component parts of compressors up to 3 hp. are machined and assembled. Then they are incorporated with the other essential equipment in an airtight metal housing, factory tested, and lubricated for long-time, trouble-free service.

In the machining and grinding section each man attends two machines, but no single operation requires more than 45 seconds. Without crowding equipment, floor space has been laid out almost down to the square inch, with the result that the productive capacity per square foot, measured in value of output, is nearly four times as great as when the same work was conducted elsewhere. At the same time it is done more accurately, compressor crankshafts, for example, being held to tolerances of plus or minus two ten-thousandths of an inch.

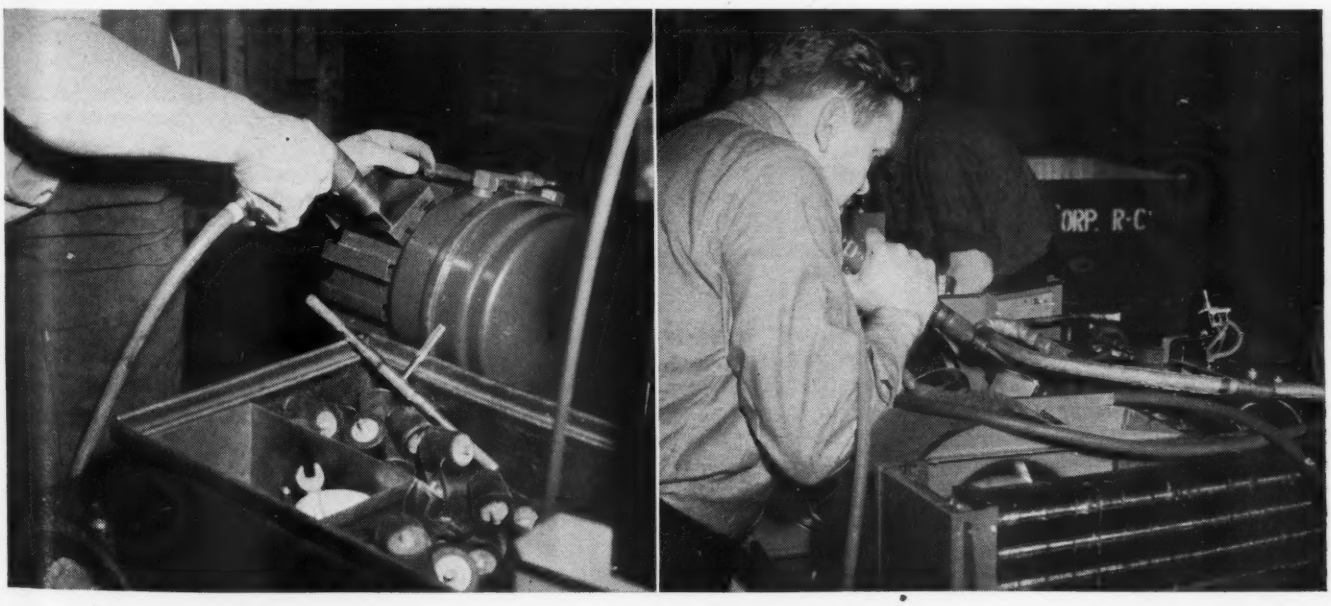
After the different elements of the refrigeration units have been put together with the aid of labor-saving jigs, fixtures, and tools they are carried largely by overhead conveyor systems to a central section where they are made up into complete plants, tested, and sealed. Refrigeration units for 5-hp. air conditioners are assembled in another part of the building, within a glassed enclosure. There the layout is in the form of a loop, around which the work moves on a roller conveyor to the various workmen's stations.

Full advantage is taken of the convenience, dispatch, and labor savings afforded by the liberal use of pneumatic tools. Several hundred of them, ranging from small screw drivers to larger, more powerful impact wrenches, are in service. In some instances tools of certain types are provided even though they may be needed but infrequently. Although most of the tools are on assembly operations they are also much in evidence in the foundry. Typical examples of the work they perform throughout the plants are shown in accompanying illustrations.

Compressed air at 100 psi. discharge pressure for operating the tools and for various other purposes is furnished mainly by large machines with an aggregate capacity of around 9000 cfm. In order to eliminate troubles caused by moisture, the air is dehumidified by refrigeration. Water that has been chilled to 36°F. is circulated through heat exchangers countercurrentwise to the air coming from the compressors. The air goes into distribution lines at around 42°F. In addition to the main units, smaller ones that supply air for sandblasting and other miscellaneous services are located near the points of application. Two 50-cfm. machines boost some of the 100-psi. air to 300 psi. for use in testing refrigeration equipment.

The changes in the nature of the company's business have brought about several changes in the corporate structure and in the name. At an early stage, the York Manufacturing Company recognized the need for a marketing organization. To meet it, fourteen construction companies—each with its engineering sales, erecting, and financial departments and owned independently of York but working closely with it—were formed in the United States and Canada, with others abroad. Those concerns prospered and became important factors in the field of refrigeration and air-conditioning contracting. By 1927 they were supported by 71 branch sales and service outlets in the United States. That year control was centralized by consolidating all construction companies with York and acquiring Arctic Ice Machine Company, of Canton, Ohio, York Oil & Chemical Company, and York Milk Machinery Company, the whole being incorporated as York Ice Machinery Corporation. In 1928, U. S. Freezer Corporation, of Brooklyn, N. Y., was purchased.

The firm name remained the same until 1942 when the present one, York Corporation, was adopted.



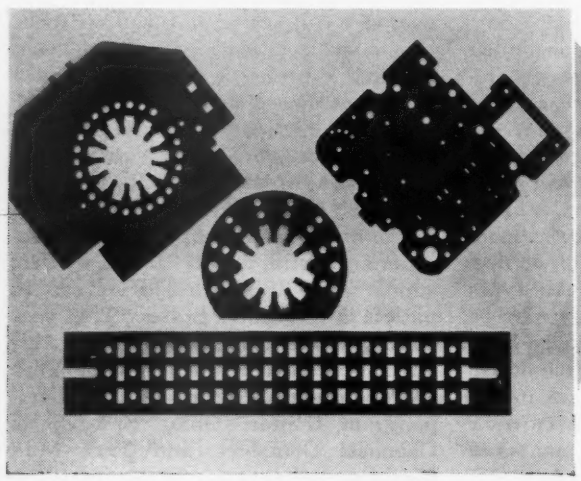
ASSEMBLING SMALL CONDITIONERS

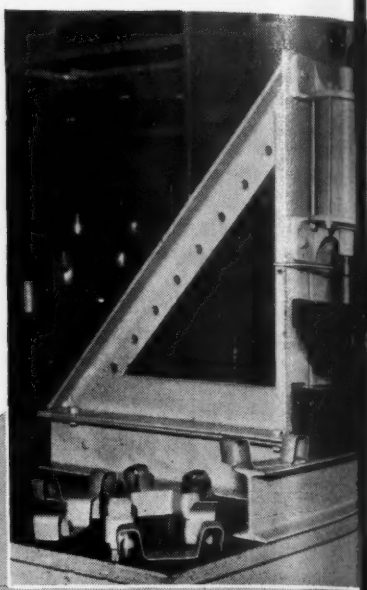
Air conditioners for single rooms, many of which are sold by Philco Corporation, are assembled in a separate department and there, too, air-operated tools are extensively utilized. The picture at the left shows a workman using a small pneumatic tool to drill holes through a template for the purpose of attaching a name plate. At the right, the plate is being put on with ease by means of an air-driven screw driver.

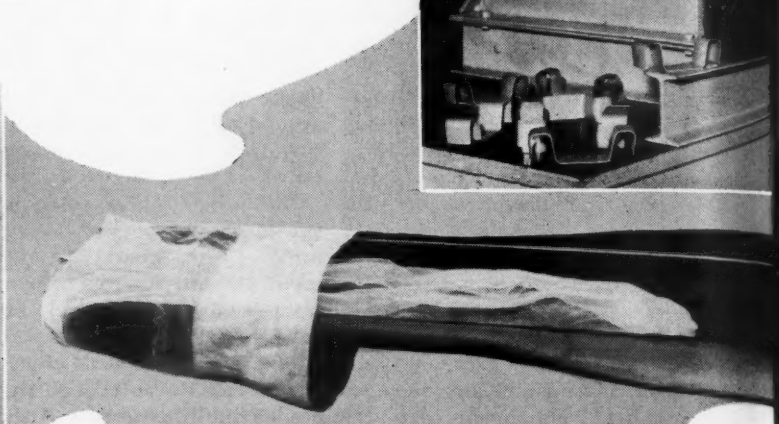
Laminated Plastics for Industry

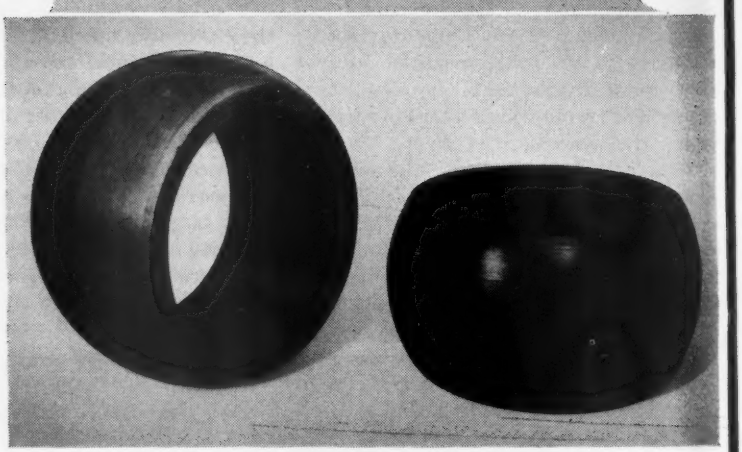
Compressed Air Has Become a Vital Force in Their Production

Carlton C. Porter









A FEW SYNTHANE PRODUCTS

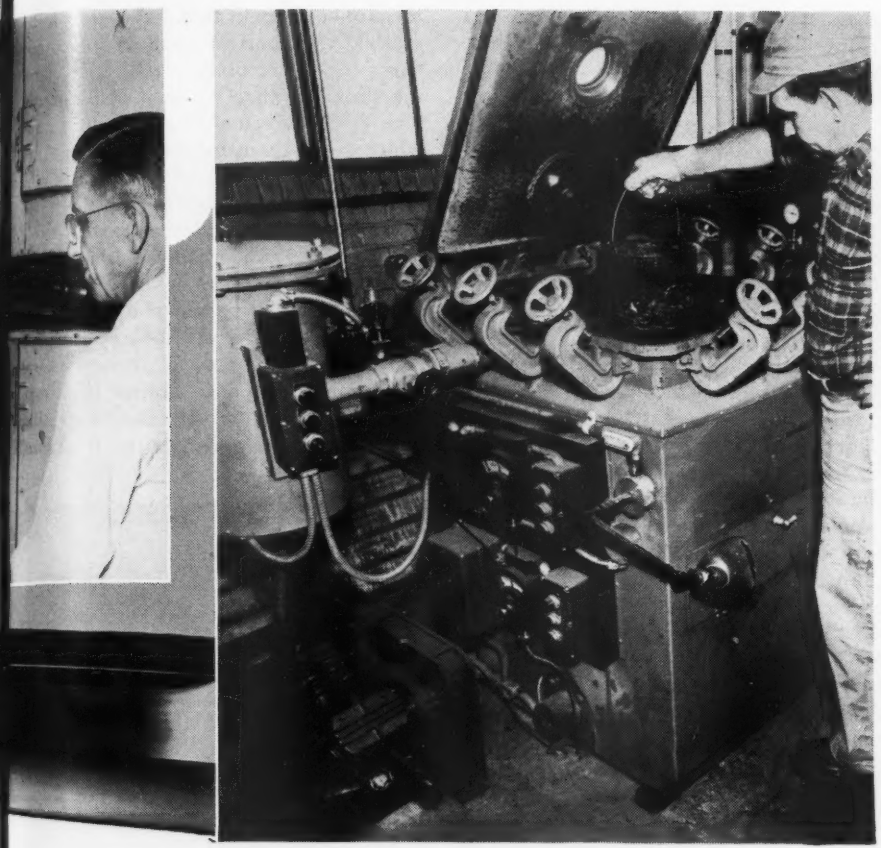
Synthane, a uniformly dense, solid material produced by applying heat and pressure to layers of paper or fabric impregnated with a synthetic resin, is made in the form of sheets, rods, and tubes of various grades, colors, finishes, and thicknesses or diameters. Three of its diversified applications are illustrated here. At the right are bearings for heavy rock crushers that must withstand great impact. A form for inspecting nylon stockings in a hosiery mill, upper-right, presents a smooth, snag-free surface and a solid black color against which defects can be readily detected. Punched components for radio, television, and other electronic devices are shown above. They are of light weight, yet possess the necessary insulating qualities and have good moisture resistance and physical strength.

THE man who tries to be all things to all people usually winds up a failure. But in industry, many a product pays off because of its adaptability. The more uses it has and the wider its field of application the better. One group of materials—laminated plastics—has won an admirable place for itself as the work horse of the plastics family because it has such a variety of desirable qualities that it meets a need in well-nigh every industry.

Take sheets of paper, cotton, nylon, glass, or asbestos fiber, impregnate them with phenolic or melamine resins and polymerize them in layers under heat and pressure, and you get a material that is strong but light, easily machined, resistant to impact, abrasion, moisture, and chemicals, and an electrical insulator. The housewife is familiar with these plastics both in their decorative form and as counter and table tops which don't stain, scorch, or mar. To the industrial designer who must often specify combinations of properties, they are of ever-present help.

One concern, Synthane Corporation of Oaks, Pa., started modestly 21 years ago with the intention of making top-quality laminated plastics for industrial applications, and it has yet to veer from that course—in fact, is today one of the largest manufacturers of materials of this kind. Its product, called Synthane, serves us daily in a score of ways, often hidden. Chances are that the breaker arm in your car's distributor, the seal washer in its water pump, and the thrust washers in its differential are made of it. So, too, may be the tube sockets, coil forms, and other parts in your radio and television receivers. Probably the rayon and nylon you wear were wound, as yarn, on Synthane bobbins. Because of its impact strength, it is used as bearings in the huge power shovels that grade superhighways and in the landing gear of giant B-36's. In the noses of big airplane propellers it supports the wires that carry deicing current to the blades. It serves as ball-bearing retainers in hundreds of machine tools and precision instruments, and, in molded form, as conical clutches and step pulleys in lathes.

Giant transformers which feed current to power lines have coil-winding supports of Synthane. Some engineers specify it for electrical bushings in heavy-duty diesel-electric generator units. These bushings, approximately 3 inches in diameter, are made by first macerating sheets of plastic into small, irregularly shaped pieces and then molding the latter under high pressure. This material is characterized by high mechan-



AIR-AIDED PROCESSES

Punched Synthane parts are furnished to some customers impregnated with wax to increase their resistance to moisture. Impregnating is done in the Stokes machine shown at the left. The basket of products being placed in it will first be heated to drive out the contained moisture, and then the air will be withdrawn from the space by the Ingersoll-Rand vacuum pump illustrated at the lower-left to promote the absorption of liquid wax by the parts. When greater wax penetration is desired, the treatment is followed by placing the chamber under 25 psi. pressure from the shop air line. To produce designated shapes for certain applications, laminates made with a special resin are reheated and postformed by means of dies that are actuated by a Mead 5-inch air cylinder. The picture in the center of the two pages shows such a press turning out springy M-shaped pieces that hold Synthane caps on sizing bobbins in textile mills.

ical strength, good dielectric properties, and ease of accurate machining.

From the outset, Synthane's production has been for a dual purpose, so far as its markets are concerned. Laminated plastics are made in three basic forms—sheet, rod, and tube—and are sold to customers who may fabricate them in their own establishments. But the corporation itself converts them, perhaps to a greater extent than any other manufacturer in the field, into finished components for the automotive, radio, machine-tool, petroleum, chemical-process, and textile industries, among others. This has naturally led to a steady expansion of its fabricating department and the increasing use of automatic machines.

The plant was the first in the United States to adopt the now widely used system of heating its big laminating presses with high-pressure hot water. It also has relied to an increasing extent upon compressed air and its opposite, suction, to perform many important services. Today, air under pressure is as essential to the production of Synthane and its fabricated parts as is electricity, and the task of supplying that air is easily the biggest power-consuming one in the plant.

Considering the job of providing compressed air, the story starts with a trio of Ingersoll-Rand single-stage machines. The oldest, now on stand-by duty, is an 8x9-inch unit; the second, acquired in 1943, has a 9x9-inch cylinder. Each is operated by a 25-hp. motor and supplies air at 75 psi., discharge pressure. The third, of the same size as the latter, is driven by a 30-hp. motor and was put in service in 1947 when the company was preparing to build an addition which brought its total floor space to 145,000 square feet. At that time a third boiler with automatic burner controls, air-actuated, was set up to maintain uniform pressure and temperature for process equipment.

The two compressors in daily use deliver into a common header, at the far end of which has lately been installed an I-R aftercooler of the water-tube type to remove moisture from the line. Well water at a temperature of 54°F. is used for cooling. The machines furnish air for the operation of chucks on automatic machines and for the dust-removal system which, in a laminated-plastic plant, is vitally important. Machining large quantities of the material calls for the continual removal of dust and chips. These are sucked up through nozzles positioned near each tool, and are carried off through flexible metal tubing which leads to overhead pipes. This arrangement, plus the efforts of vigilant janitors, does much to give the factory its tidy appearance.

Air from the main compressors also actuates the plant's air valves. One of these, for example, regulates the variable-stroke pump which feeds water at a constant pressure of 2600 psi. to the platen presses. To guard against interruptions in production, a reserve of water is kept under like pressure in a steel "air bottle" some 18 feet high, 30 inches in diameter, and having walls 3 inches thick. This accumulator is charged with air by a vertical 2-crank, 3-stage compressor which provides a working pressure of 3000 psi. and consumes a rated 23.2 hp. A valve on the tank automatically closes when the pressure in the system drops to a point below the internal pressure. This reserve of about 50 gallons can operate four big platen presses for three to four hours should the pump or main air supply fail for any reason. To further safeguard against unintentional shutdown, a small auxiliary compressor is on stand-by duty in the platen-press department ready to meet the air needs of the valves on the big presses.

Air from the main compressors also serves to operate the 7x7-foot boiler control board. A pump of 150-gpm. capacity boosts the water pressure from 175 to 230 psi. and delivers it hot to the presses at 200 psi. Cold water at 200 psi. pressure actuates the platen presses, which are then closed at 2600 psi. by manually controlled valves. Next, hot water is pumped from the boilers to heat the "book" of laminations. The main volume of water for the presses is fed by four pumps, one of them a stand-by.

Above and beyond these heavy-duty uses, air under pressure serves scores of labor- and cost-saving purposes throughout the factory. In the impregnating room, for example, where rolls of paper or fabric up to 100 inches wide are impregnated with resin varnishes, compressed air allows the big treating machines to run virtually unattended and prevents damage to costly stock. Dick-out guides press lightly against the edge of the material as it comes from the machines. Should the material creep—start to go out of line—the guide is deflected and a diaphragm straightens the roll instantly by adjusting a pivoted casting that supports the rollers. Air is fed to this device at a working pressure of 5 to 6 psi. by means of reducers. Valves

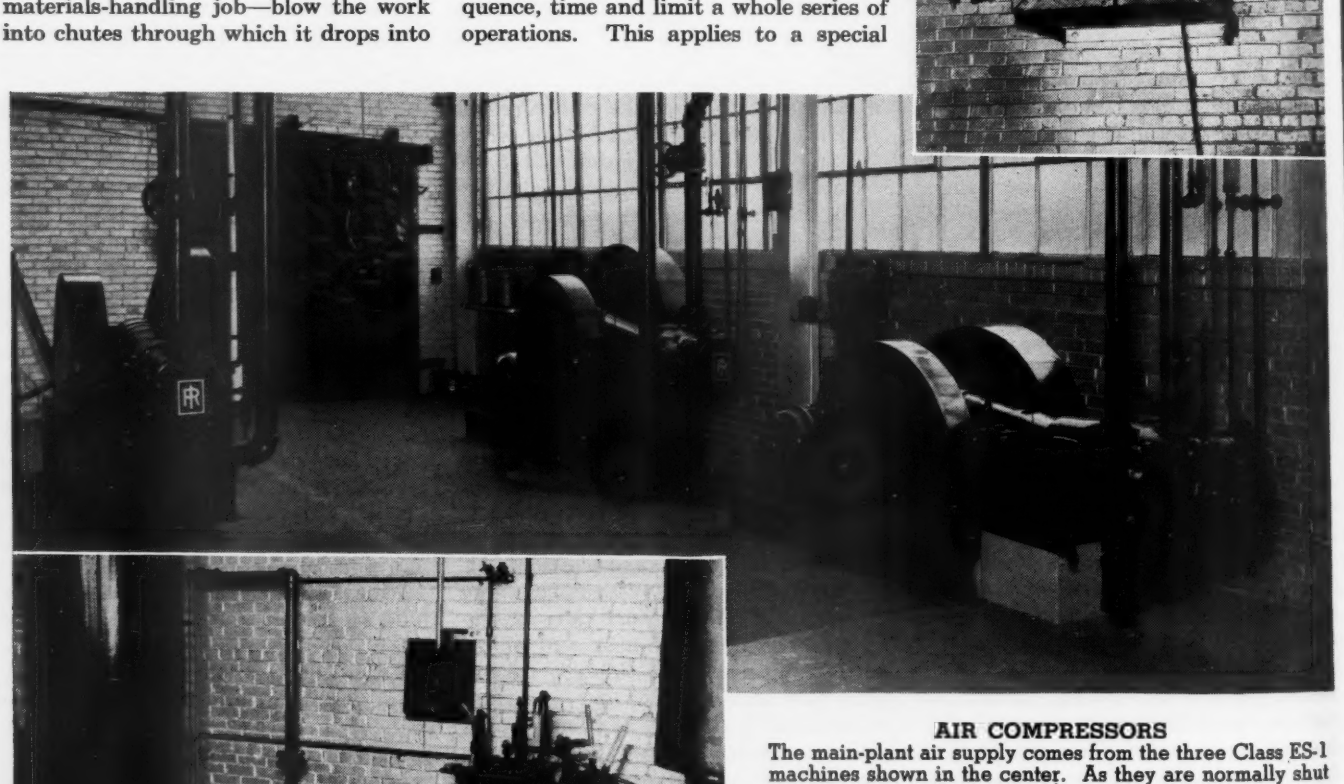
which regulate the flow of hot water to the coating machines and thus control the temperature likewise are air-operated. In the tube-winding department, laminated tubes are produced by rolling the impregnated stock tightly over heated rolls. Pressure for the important job of keeping the winding tension constant is provided by hand-controlled air cylinders with a bore of 8 inches and a stroke of 4 inches.

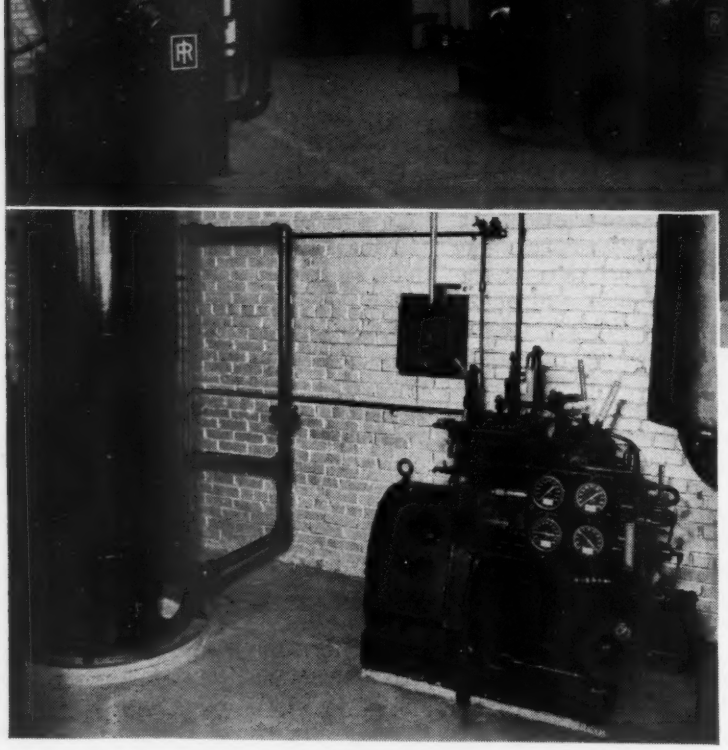
In a 50x160-foot room are produced thousands of plastic bobbins for the nation's textile mills—particularly for those handling rayon and nylon where bobbins must withstand attack by chemicals, moisture-laden atmosphere, and the crushing force of thousands of turns of yarn. In this fabricating department, which is heated by fin-and-tube convectors, air valves regulate the flow of the heating water. Similar valves control the heat in the tool room, in most of the plant offices, and in the cafeteria. Powers and Minneapolis-Honeywell thermostats actuate the valves.

It is in the production of carefully machined parts, however, that compressed air functions most dramatically. Streams issuing from tiny adjustable tubes on the beds of punch presses actually perform a materials-handling job—blow the work into chutes through which it drops into bins. Other air lines on the same machines may be directed so as to blow scrap punchings into waste barrels.

The history of the air-powered machines in the Synthane plant is a story of the ingenious application of compressed air to the movement and control of chucks and tool heads, as well as one of markedly increased output and reduced operator fatigue. Four years ago, the superintendent of the automatic screw-machine department was detailed to set up a special division for machine design. He's still at it, aided by a small staff, and today more than 100 lathes, presses, etc., are equipped with Bellows cylinders to do the work formerly done by muscular effort. Ultimately, the corporation plans to convert from manual to automatic operation wherever production volume warrants.

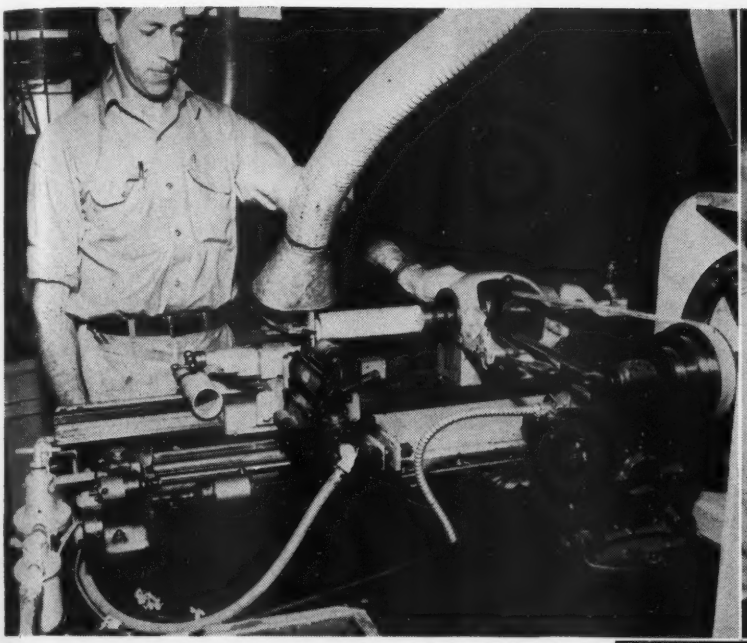
In the bobbin department, for example, output increased 75 percent when the lathes, which finish the outer surfaces of the bobbin barrels, were changed over from hand-wheel to air power. Pressing a button now moves the carriage, keeps the feed constant, and returns the carriage to the starting position. On some machines with air-actuated travel, microswitches, hit in sequence, time and limit a whole series of operations. This applies to a special piece of equipment that is designed automatically to fabricate pulleys for tuning cords of radio receivers—pulleys of varying sizes less than an inch in diameter. The blanks are loaded into a magazine which feeds them into a drilling fixture where air engages and withdraws the drill, advances the tool during the turning operation, and indexes the drill-table feed. In addition, it blows dust off the drill while vacuum removes it from the turning tool. Air powers the drill feed in making breaker arms for automobile distributors, and at 350 psi. pressure rams home the Oilite bronze bushings. An air-driven chuck is used in drilling radial holes in ball-bearing retainers.

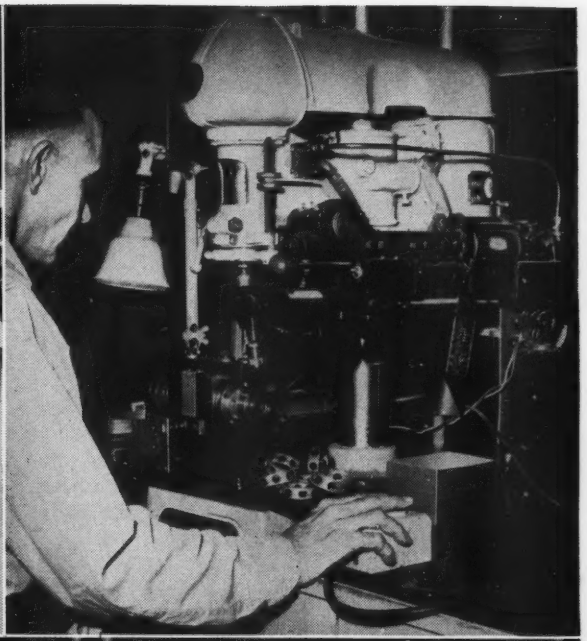


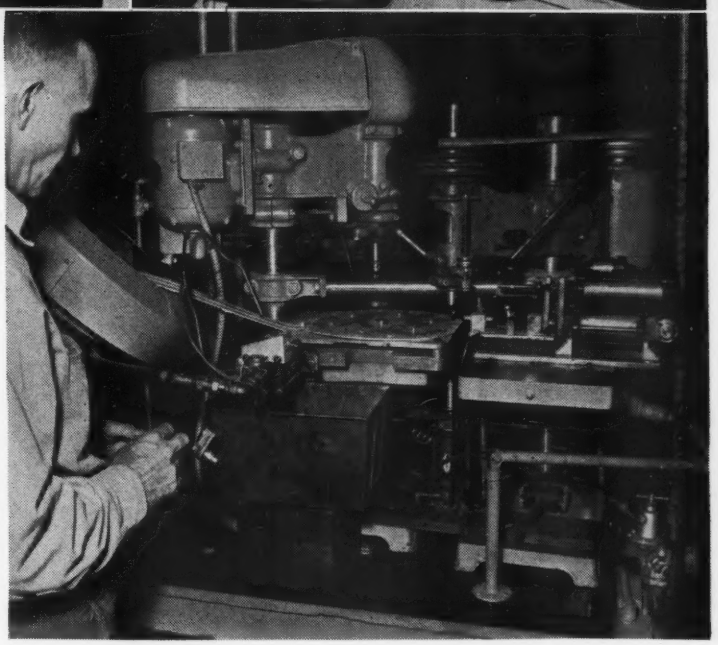


AIR COMPRESSORS

The main-plant air supply comes from the three Class ES-1 machines shown in the center. As they are normally shut down on week ends and holidays, the pneumatically operated fire-alarm whistle is connected with the small wall-mounted Type 30 unit pictured at the top. When the receiver pressure drops below a given point, the compressor automatically starts to run, thus insuring an adequate supply of air at all times to actuate the alarm. The vertical 3-stage compressor at the left furnishes air at 3000 psi. pressure to the accumulator standing left of it. The latter vessel, which is made of 3-inch steel plate, is partially filled with water and is tied in with the hydraulic system that puts pressure on the heated laminates to form plastic sheets. The accumulator evens pressure pulsations and, in the event of failure of the pumps, will operate the platen press for four hours.







MACHINING OPERATIONS

More than 100 lathes, presses, and other machine tools on which Synthane parts are finished to customers' specifications are equipped with Bellows air cylinders which both increase the speed and accuracy of the operations and lessen worker fatigue. Application of these pneumatic aids has expanded over a period of four years under the direction of a special machine-design division. The machine illustrated at the right processes small pulleys used on the tuning dials of radio receiving sets. The parts are fed from the hopper at the left to the rotary table, which is then indexed to the drilling station by a Bellows motor. Next, a drill-press feed is lowered to drill the center hole in each pulley in turn. Following retraction of the drill, the piece is raised by an air cylinder until it engages a spindle that turns it while another cylinder moves a tool in from the side and withdraws it after it has machined a groove in the edge. The part is finally returned by cylinder action to the table, which rotates until it falls out. The entire cycle is automatic. The drill press shown at the upper-right drills eight holes in retainers for ball bearings. Every piece is automatically indexed to each station in turn, after which the machine stops. The man in the picture above is machining a bobbin for a textile mill. First, it is counterbored for a distance of about 1½ inches in from the end, then the tube end is faced, and next two recess grooves are cut in the inside face. All these operations are done automatically. Finally, the piece is reversed and the cycle is repeated at the other end.

With the last hole finished, a trigger touches a microswitch and shuts off the tool.

On standard production, many machines in the Synthane plant are provided with the Senacon feed made by the Bellows Company. Generally, speed of travel is regulated by dashpots, which permit the operator to adjust the rate of tool advance by varying the flow of oil through an orifice. In the case of one such installation, which threads television coil forms to provide a groove for the wire, a 1-inch Bellows piston operates the cross slide on which the threading tool is mounted—engages and disengages the tool to give the correct number of thread turns. In another application, a quick-return drill-press feed has been adapted to control four distinct movements of a milling table in order to mill holes of irregular shape.

Although the main air system throughout the plant is designed for week-end shutdown, one essential but rarely used piece of equipment—the fire alarm—must be on duty seven days a week. Powered by air, the whistle is served by a separate 2-stage Ingersoll-Rand compressor which supplies air at 100 psi. and is mounted on a steel wall rack in the fabricating department. Because impregnating machines are occasionally operated week ends, their control mechanism is cut into the fire-alarm system.

In addition to the laminated, molded-laminated, and molded-macerated forms in which Synthane plastics are made, designs sometimes call for postforming the material. Special resins are used for this process, by which the blank is reheated and shaped by dies of Synthane in a Mead air press having a 5-inch cylinder.

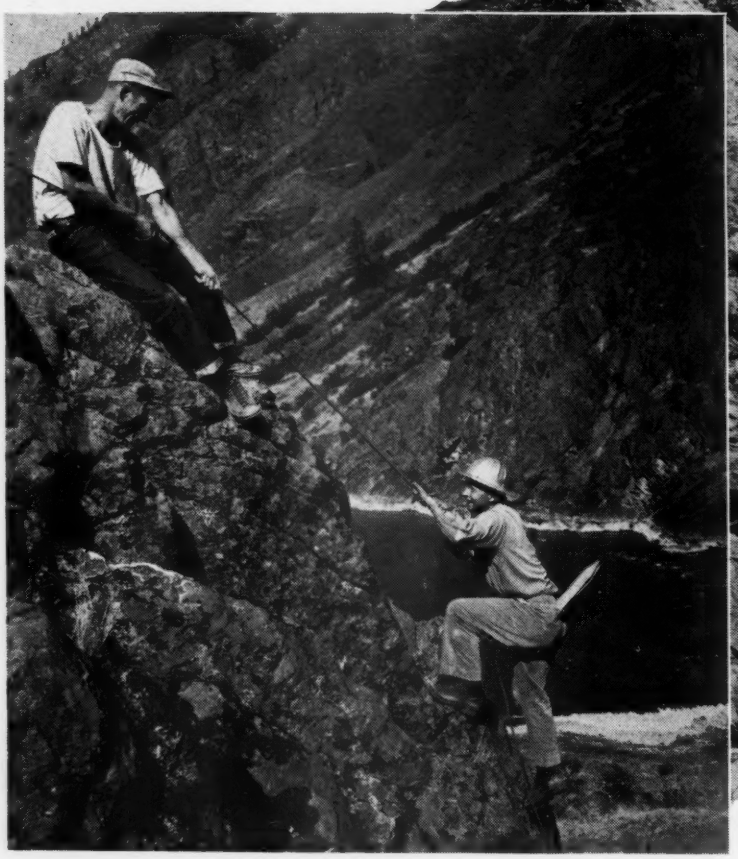
The latest application of compressed air in the factory is in the big varnish storeroom where a new I-R air hoist of 1-ton capacity, mounted on an I-beam, makes light work of juggling 1400-pound drums. Finally, air expedites a job performed by a Stokes impregnating machine.

For some of its customers, Synthane Corporation impregnates punched parts with wax to increase the moisture resistance of the material, particularly along the edges. The punchings are heated in the machine and the released moisture is extracted by a pump. Then the compressor, used as a vacuum pump, draws the liquid wax into the parts, which are next thinly coated by dipping. When products require greater than normal wax penetration, the vacuum is shut off and air at a pressure of 25 psi. is applied from the shop system.

Hel any Challenge am

TOUGH TERRAIN TO CONQUER

Shown looking down into the abyss of Hells Canyon are H. T. Nelson (right), regional director for the U. S. Bureau of Reclamation, Boise, Idaho; Ivan Tuescher (standing), chief of the survey party; and Francis Hart, planning engineer, Boise.



SURVEYORS' TORMENT

Alpine tactics had to be resorted to many times a day. In places the canyon rims are several thousand feet above the river, and a fall would have meant death.

ACCORDING to the U. S. Bureau of Reclamation, adjectives stronger than any at the commond of Hollywood's publicity drum-thumpers would be needed to describe adequately the rugged austerity of Hells Canyon. This precipitous piece of landscape is on the stretch of the Snake River that forms the boundary between the states of Idaho and Oregon. The Bureau is interested in it because it would make a good dam site, and last summer had a party of engineers looking it over and laying the groundwork for subsequent detailed planning of a scheme that will one day be laid before Congress with a request for authorization to proceed with construction.

The canyon has long been considered a fit habitat for no creatures other than mountain goats. It is deeper than the Grand Canyon of the Colorado, and the turbulent stream at the bottom tosses boats around like match sticks. The Lewis and Clark party was unable to navigate it in 1805, and the John Jacob Astor Expedition lost three men in trying it six years later. Since then, few persons have tarried long in the area.

Uninviting as it is, however, Uncle Sam's dam designers look upon the canyon with a feeling akin to affection, for it has all the physical attributes for a structure that would rival Hoover Dam in height and daring conception. They envision for the site a tapered concrete plug 742 feet high, 674 feet thick at the base and 45 feet at the top, and 1740 feet across the crest. With a mass of 6,200,000 cubic yards, it would be the world's third largest concrete structure. Its erection would keep up to 6000 men busy for six or seven years and would cost around $333,000,000.

The reward would be a 900,000-kw. generating station to feed more electrical energy to the power-needy Northwest.

Hellanyon engeam Builders

PHOTOS BY STANLEY RASMUSSEN, U. S. BUREAU OF RECLAMATION

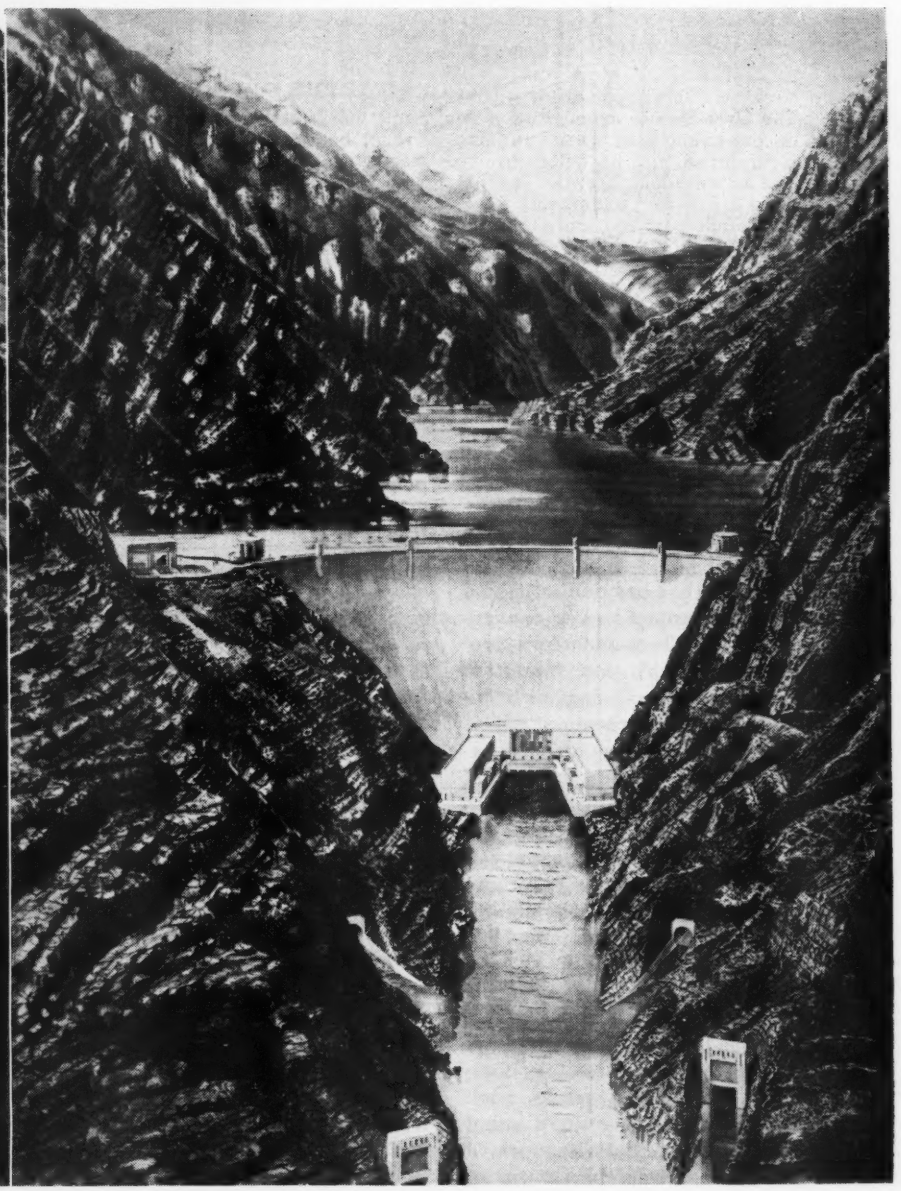
In addition, the dam would aid in controlling floods on the lower Snake and Columbia, into which the Snake empties near Walla Walla, Wash. The 4,400,000-acre-foot reservoir would no doubt in time attract hordes of sightseers and recreationists, especially fishermen. Unlike most Bureau projects, the benefits would not include land irrigation.

Hells Canyon is some 150 miles north of Boise, Idaho. The gash separates the Seven Devils Range in that state from the Wallowa Mountains in Oregon. The only avenue of access is a single-lane, so-called road that reaches Eagle Bar, Idaho, 16 miles downstream from Homestead, Oreg., and is not noted on most maps. From that point on there is not even a path. Before dam construction could begin, a big job of roadbuilding would have to be done.

The 7-man party that made the preliminary investigations found the assignment far from a sinecure. The near-vertical topography presented constant hazards to life and limb. The trailless terrain could be negotiated only on horseback or foot. In either case, climbing was an ordeal. The horses developed sores from continually shifting saddles, and the men found the going rough on skin, clothes, and footgear. Shoes lasted an average of ten days. Midday temperatures exceeding 102°F. were the rule rather than the exception, and a high of 117° was recorded. Nineteen rattlesnakes were killed, giving a hint as to how the river got its name. There were compensations, however. During off-duty hours the party caught sturgeon in the river, the record fish being a 200-pounder.

PROPOSED DAM

The similarity to Hoover Dam is apparent in this artist's conception of the structure. The concrete barrier would rise as high as a 70-story building and call for some twelve million tons of concrete. The ultimate generating capacity of the twin stations at the base would be 900,000 kw.



First Major Change in Design in 50 Years Distinguishes

New Portable Compressor

Allen S. Park

THE GYRO-FLOW 600

The Gyro-Flow is mounted on a steel frame that is carried on pneumatic-tired wheels running on roller bearings. It is equipped with an automotive-type steering mechanism and an extra-long drawbar that permits easy towing. Fuel tanks are housed underneath steel aprons along both sides of the undercarriage, and each holds 45 gallons—more than enough for a full shift of operation. The entire unit can be closed and protected against dirt and weather by lowering the close-fitting steel side covers that are shown here in raised position. Although it is carefully built of the highest-quality materials obtainable, the new design effects such a great saving in weight that it is approximately 45 percent lighter than one reciprocating-type 600-cfm. portable now on the market.

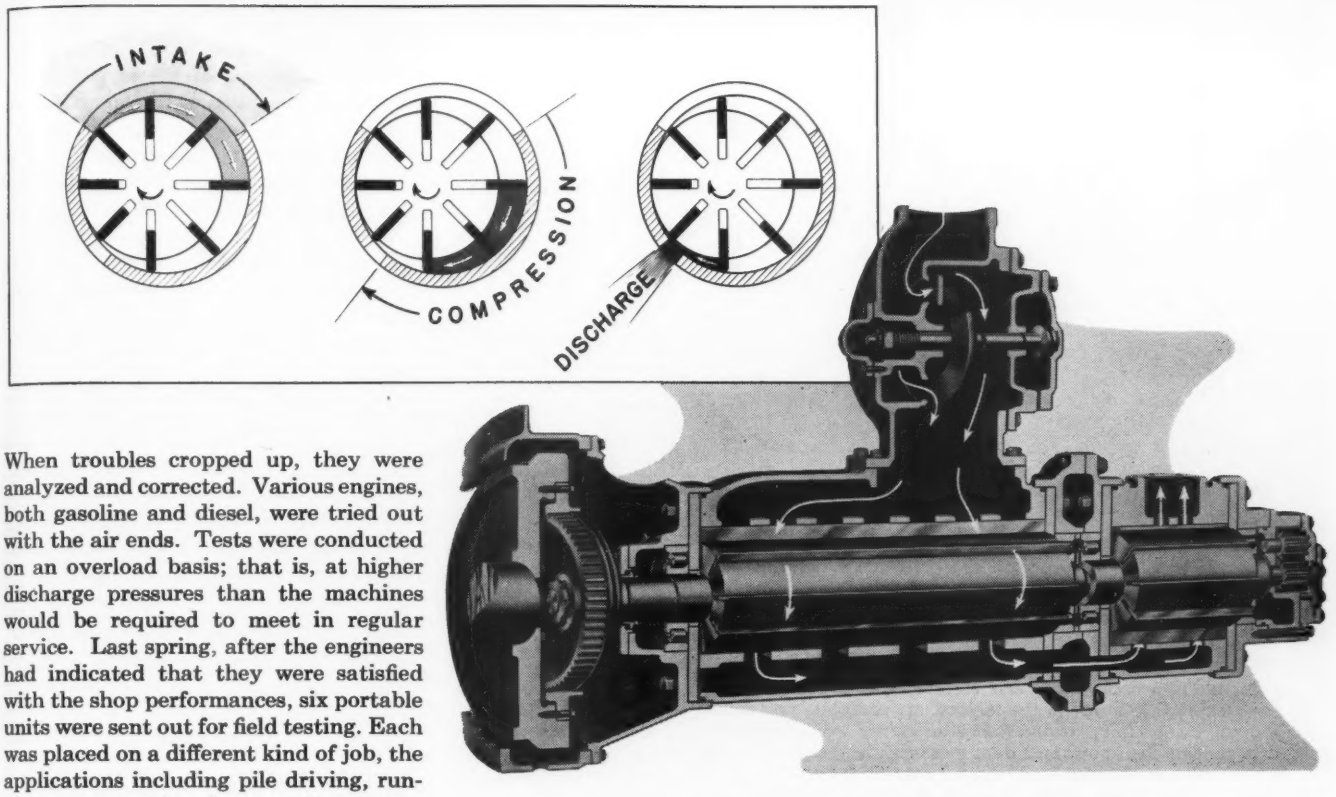
THE first fundamental change in the design of portable air compressors since these machines were introduced almost 50 years ago has been announced by Ingersoll-Rand Company. A new 600-cfm. unit utilizes a rotary-type compressor instead of the traditional reciprocating type. Called the Gyro-Flow, it is being placed on the market following extensive and rigorous factory and field testing that has demonstrated its numerous advantages over conventional machines. These include a pronounced cut in weight; cool operation with attendant virtual elimination of lubricating troubles and consequent reduction in wear; cool discharge air with resulting long life of delivery hoses and freedom from clogging of drill passages by fragments of rubber loosened through heat deterioration; full rated delivery of even-flowing, nonpulsating air at 100-110 psi. pressure; high compression and volumetric efficiencies; and sustained low consumption of lubricating oil.

The new unit is driven by a 2-cycle diesel engine that is smaller and lighter than the 4-cycle types with which many portables are equipped. The rotary compressor is also smaller and weighs much less than a reciprocating unit of equal capacity. Although it does its work in two stages, its operating characteristics are such that it requires no intercooler and no receiver. Mainly for these reasons, the new machine, including its 4-wheeled, pneumatic-tired chassis and a full supply of fuel, weighs approximately 9500 pounds as contrasted with 13,800 pounds for one 600-cfm. reciprocating-type portable now in service. The advantage this gives it in mobility is obvious, and the significance thereof is realized when it is considered that these machines are widely used on roadbuilding and construction jobs where they must be periodically moved over uneven, steep, or soft terrain.

Development of the rotary portable was the natural result of the prevailing trend towards equipment of ever-increasing capacity for the construction industry. As power shovels and haulage units grew steadily larger, it became necessary to drill rock faster, and more powerful drills appeared especially in the wagon-drill class. These drills call for more air, with sustained pressures of 100 psi. or higher. Furthermore, with the tendency to put down deeper holes and thereby increase excavation per lift, more air is needed for blowing holes to remove cuttings and to prevent binding of the bit. Whereas a 500-cfm. portable—until recently the largest size offered by most manufacturers—formerly comfortably powered two large wagon drills, the factors just mentioned have brought about a condition under which it cannot always meet this requirement adequately.

To remedy this situation, Ingersoll-Rand engineers began to look into the matter of developing a larger portable several years ago after first having rejected as unsound the idea of operating current models at higher speeds. It was apparent that, if they followed the design of the existing line of reciprocating machines, it would be necessary to either increase cylinder sizes or add more cylinders. Neither course was desirable because either one would produce larger and heavier and therefore less portable complete units. Their aim lay, rather, in the other direction: to give users more air power in a smaller package. They found the answer by turning to the rotary design of compressor, developing a unit that would function dependably and economically under severe operating conditions, and then adopting as its driver a lightweight diesel engine that had already proved its durability and fuel economy in the construction field.

The decision to accelerate the development of a rotary machine was made in January, 1948. By May several units had been built and put on test, followed by 40,000 hours of running in the shop.

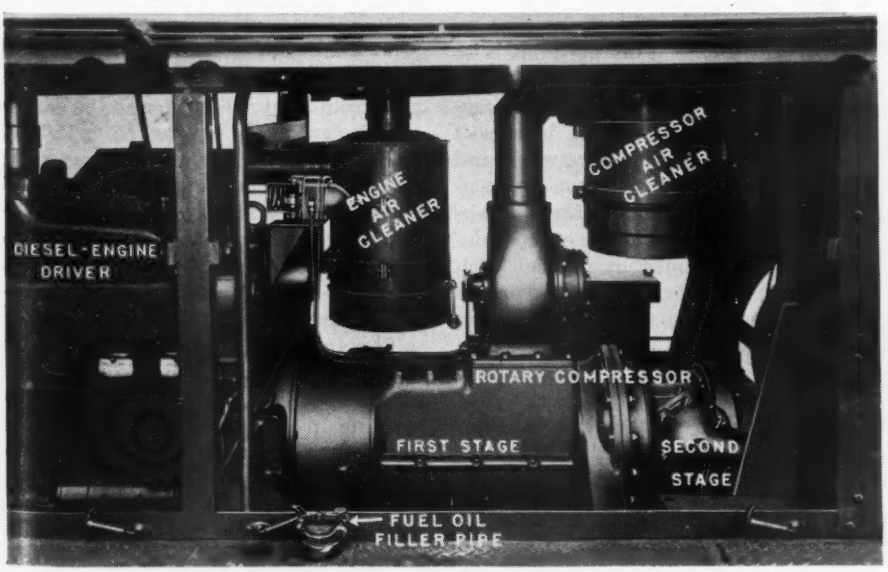


HOW ROTARY COMPRESSOR WORKS

The sketches at the top show the compression cycle of the Gyro-Flow. Vanes that move out of slots in the rotor as the latter turns at high speed are held against the cylinder walls by centrifugal force, forming pockets that first increase and then decrease in size. Air is drawn into these spaces as they are enlarging, is compressed as they grow gradually smaller, and discharged when the desired pressure is reached. There are two of these rotors arranged in tandem, as seen in the lower picture. Arrows mark the course of the air, which is fed from the volumetric regulator at the top into the first stage of the compressor. After being compressed there to 30 psi., it goes to the shorter second-stage cylinder at the right, where it is further compressed to the final minimum pressure of 100 psi.

When troubles cropped up, they were analyzed and corrected. Various engines, both gasoline and diesel, were tried out with the air ends. Tests were conducted on an overload basis; that is, at higher discharge pressures than the machines would be required to meet in regular service. Last spring, after the engineers had indicated that they were satisfied with the shop performances, six portable units were sent out for field testing. Each was placed on a different kind of job, the applications including pile driving, running pavement breakers on city streets, and operating rock drills in a quarry and on roadbuilding and general construction work. A factory-trained engineer was assigned to each machine to observe and report on its operation, and with instructions not to baby it. After the field trials had continued for several months and only minor troubles had developed, it was decided to put the Gyro-Flow in production. One of the concerns to which a test unit had been loaned ordered nine.

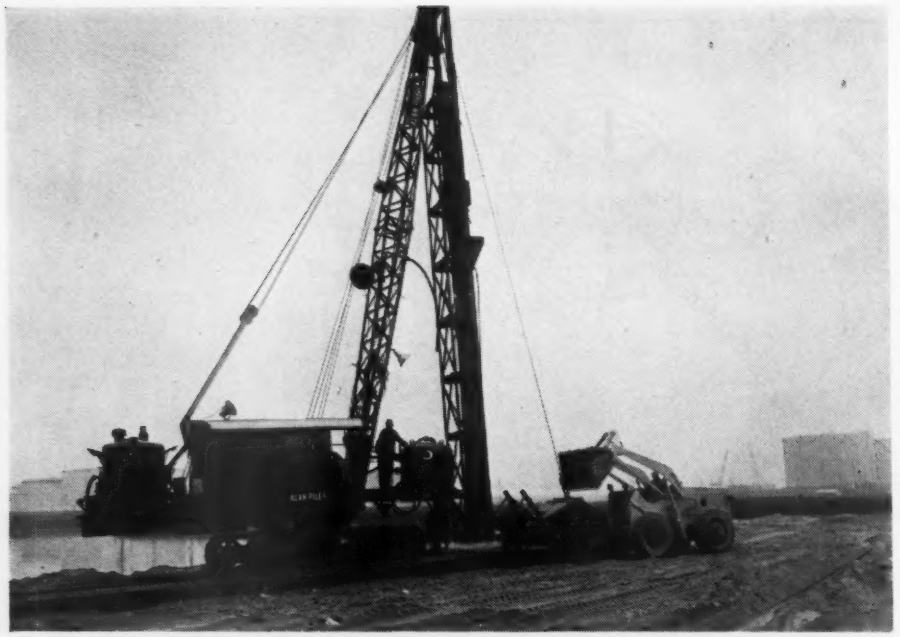
The rotary compressor is not a new type of machine, but it has been used more in Europe, where it originated, than in this country. Fundamentally, it consists of a cylindrical rotor mounted off center inside a somewhat larger cylindrical casing. The rotor has longitudinal slots in which are fitted sliding vanes. As the rotor turns, the vanes move out and are held against the casing walls by centrifugal force. Because of the off-center mounting, the spaces between the extended vanes alternately increase and decrease in size during each revolution of the rotor. Air that is drawn into each succeeding pocket as it reaches its maximum volume is compressed as the pocket grows progressively smaller, and is discharged as the space approaches its minimum size. Obviously, this produces a steady flow of compressed air without pulsations and, consequently, without vibration. No valves are needed and there are no reciprocating parts.



CLOSE-UP OF COMPRESSOR

The small size of the rotary unit becomes apparent when its height is compared with that of the section of the engine visible at the left. The engine drives the compressor through a gear-type coupling that is sealed to exclude dirt and insure long-lasting lubrication.

The principal problems encountered in designing an efficient rotary compressor are to provide for adequate lubrication and cooling and the prevention of air slippage between adjacent compression spaces and around the rotor ends. Because lubricating oil was carried out of the machine in the air stream, previous designers cut the amount of oil to a minimum. Ingersoll-Rand engineers did just the opposite and literally flooded the cylinder, vanes, and bearings. They knew



FIELD TEST

After the new compressor and various types of engine drivers had been test operated for 40,000 hours in the factory, six complete portables were assigned to jobs around the country to determine how they would perform under actual service conditions. The one shown here was mounted on the rear end of a pile driver used by a contractor on the New Jersey Turnpike for putting down large pipes to install vertical sand drains in the water-laden soil of the New Jersey Meadows. The six test units, combined, were run for more than 7000 hours before being sold to the contractors on whose jobs they had been placed.

that this would insure good lubrication, and they also found that it solves the other problems. The oil both cools the air by taking up the heat of compression and forms a satisfactory seal between compression pockets and at the rotor ends.

In order to make this multiple use of the oil workable, it was necessary to devise means of recovering the lubricant from the outgoing air stream, and this is done in a 2-stage separator that takes the place of the receiver of a conventional reciprocating-type portable. Most of the oil drops out of the air in the outer primary section when the velocity of the mixture is reduced. The finely atomized particles that remain are extracted in the inner secondary section, which consists of a series of chambers packed with a substance that has a high affinity for oil. This absorption medium will normally not need replacing for two or three years.

The oil collecting in the chambers is pumped to a reservoir in the primary section of the separator, from where it begins another cycle. It is cooled by making four passes through the cores of a radiator section mounted in front of the engine radiator, then filtered to remove any grit it may have picked up. The filter is located in an easily accessible place at the high point in the circuit so that it can be cleaned without draining the oil. From the filter, the oil is pumped to the shaft seals and bearings of the compressor and also to jets that inject it for lubricating and sealing the vanes and for cooling the air. Records kept on the test units indicate that 99.999 percent of the oil is reclaimed in the separator and that the same rate of recovery can be expected throughout the life of a machine. This economy exceeds that of any other portable compressor now available.

There are two compressor rotors—one for each stage of compression—and they are mounted in tandem on a common drive shaft. Each rotor has eight vanes made of synthetic laminated-plastic Synthane, which is described in another article in this issue. This material is so tough and resistant that vanes that have operated 4000 hours on test show practically no wear. However, it is soft enough not to erode the casing walls, and this, together with the generous lubrication supplied, eliminates the "washboarding" effect that sometimes develops in rotary machines fitted with metallic vanes. If any dirt or grit enters the compressor, the vanes and not the rotors and cylinders will wear.

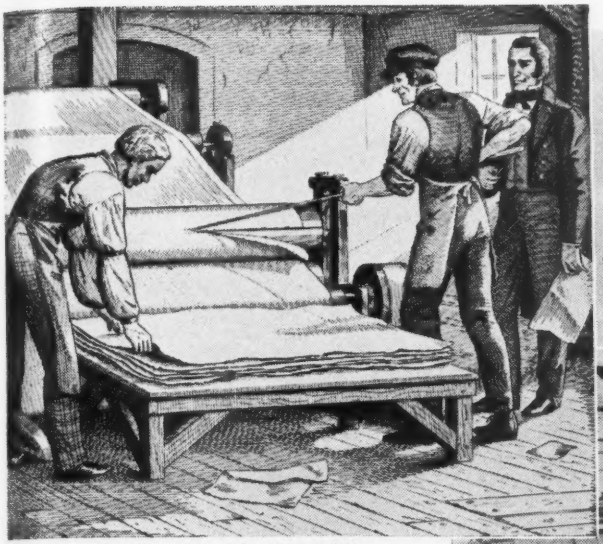
Air taken in through a screened inlet on the roof of the housing passes first through an efficient, oversize oil-bath cleaner for the removal of dust and then to a regulator that delivers it in proper volume to the first stage of the compressor. After being compressed to 30 psi., it goes to the second stage, where it is further compressed to the discharge pressure of 100 psi. The stages are proportioned so that each does half the work. Dividing the compression into two stages keeps the pressure differential between pockets low enough to reduce leakage of air to a minimum.

The combination of 2-stage compression and the use of lubricating oil for cooling is so effective in controlling the heat that the temperature of the discharge air never exceeds 200°F. under normal operating conditions. This low temperature increases the efficiency of compression and eliminates the need of an intercooler between stages. It also insures long life for the lubricant which does not carbonize and break down.

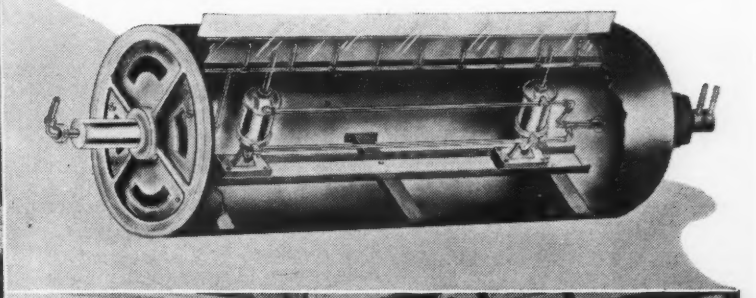
The engine that drives the Gyro-Flow is the General Motors Series 71, which is used as standard or optional equipment by 120 manufacturers of 500 industrial and agricultural machines. It is designed to function efficiently at any speed from 500 to 2000 rpm. At its normal maximum speed of 1800 rpm. in this application it has an intermittent rating of 178 bhp. It maintains its rated power well at high altitudes, which is important insofar as compressor operation is concerned. It has an electrically actuated starter, and starts on regular diesel fuel. As the action of the rotary compressor is such that no air is compressed until the rotors gain speed, the engine starts against no load and no clutch is required.

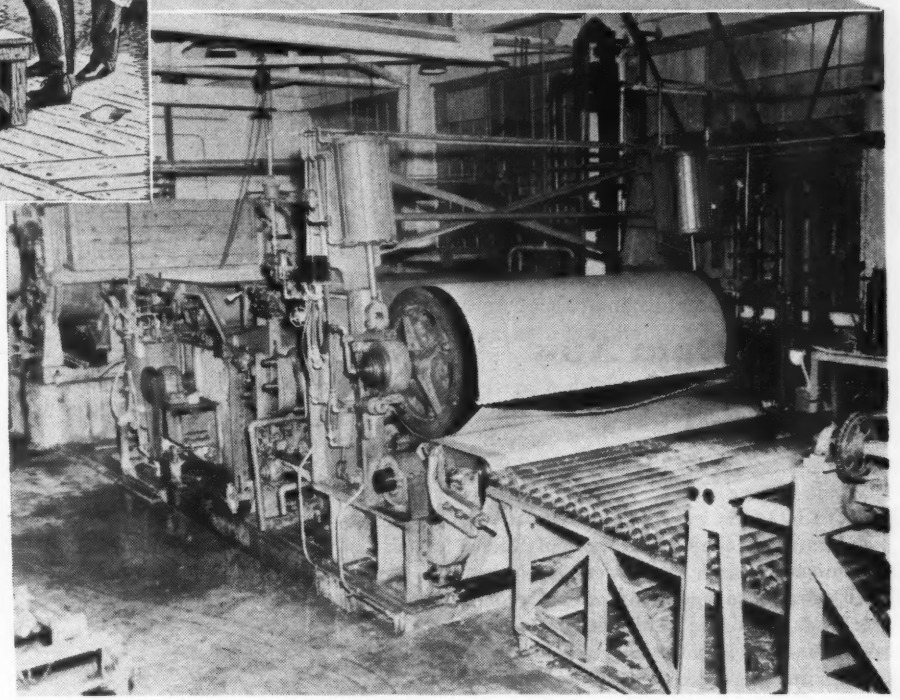
An outstanding feature of the Gyro-Flow is the system of regulation. It is the first one applied to a portable compressor that permits the air output to be controlled gradually and smoothly from full capacity to zero. Its effect is to deliver just enough air to meet the fluctuating demand at all times, and this insures the maximum possible fuel economy. From the full rated capacity of 600 cfm. down to 60 percent of capacity, or 360 cfm., the output is controlled solely by regulating the speed of the engine. As the demand for air decreases, the pressure in the separator rises and is transmitted to a regulator on the engine governor that reduces the speed. Throughout this capacity range the air pressure rises from 100 to 106 psi., and the engine speed is gradually lowered from 1800 to 1100 rpm. Below 60 percent of capacity, output is controlled both by reducing the engine speed and throttling the air intake to the compressor. Throughout this range the pressure in the separator varies from 106 to 110 psi., and the engine speed goes as low as 700 rpm.

The low temperature prevailing throughout the air circuit eliminates explosion and fire hazards. To prevent the building up of excessive temperature and to safeguard the machines against damage in case anything should go wrong, a complete set of protective devices is provided. If the temperature of the discharging air exceeds 220°F., a thermal switch will shut down the engine. Similarly, operation will cease if the engine-oil pressure falls below 35 psi. or if the cooling-water temperature rises above 210°F.



FROM F. C. HUYCK & SONS, KENWOOD MILLS





Air Power Solves Papermakers' Problem

EVOLUTION OF SLITTING

Early fibre board manufacturers slit the pulp from the "make" roll by hand, as seen at the top-left. Years of intervening development have produced the automatic cut-off roll pictured at the top-right. A knife that is pneumatically operated and electrically controlled emerges from inside the roll through a slot at timed intervals. As it completes the cut, compressed air, issuing from jets along the slot, aids in freeing the material so that it can be stripped off the roll as a flat sheet. The bottom view shows a roll in action, with a severed sheet coming off on to a roller conveyor.

ON ONE type of papermaking machine, fibre board is built up to its ultimate thickness on a single roll. The wet pulp stock is fed to the revolving cylinder, which adds a layer with each turn. When the desired thickness is reached, the material is slit longitudinally, stripped off the roll, and laid down as a flat sheet. The roll on which the pulp is built up is called a "make" roll.

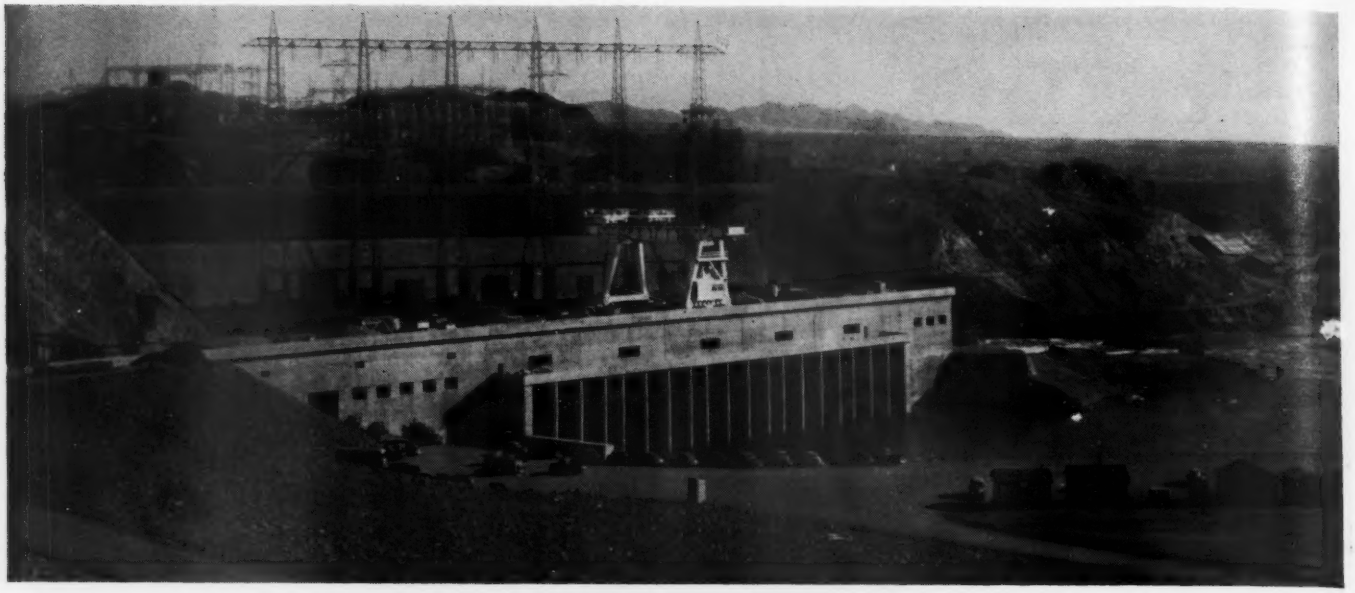
Slitting and removal of the material from the cylinder has always been a source of trouble and delay. Early papermakers made the cut by inserting a lancelike knife under the product at one end and running it across the face of the roll to the other end. While one man did this another grasped one edge of the severed sheet, unwound it from the cylinder, and added it to the pile at the end of the machine.

Mechanical cutting devices were developed in time and have taken many forms as manufacturers sought to improve their action. One of the firms that have long struggled with the problem, The Noble & Wood Machine Company, of Hoosick Falls, N. Y., has now produced an automatic cut-off roll that bids fair to eliminate the headaches that have always attended this operation. Called the Raywood, it has a knife that emerges through a slot in the roll surface when actuated by pneumatic cylinders located inside the roll.

The knife is electrically controlled through relays and an adjustable counter. The latter can be set so that the cut will be made after any predetermined number of revolutions, thus automatically providing identical sheets of uniform thickness. A clean slit is made instantaneously, and immediately afterward compressed air is released through jets stationed along the slot to loosen the wet material and aid in stripping it. Production is continuous. The roll turns at a constant speed and is not slowed down or stopped when the cut is made. New plies for the next sheet start building up without interruption.

The Raywood roll was developed after many years of trial and rejection on the part of Noble & Wood design engineers, working in conjunction with the Raybestos Division of Raybestos-Manhattan, Inc. The name Raywood was derived by combining parts of Raybestos and Noble & Wood. During that period they tried knives actuated manually and by hydraulic, pneumatic, electric, as well as cam, spring, and lever actions. Some were automatic, some semiautomatic, and both internally and externally operated mechanisms were tested. In the end, the combination of pneumatic power and electrical control was found to work best.

Raywood cut-off rolls have already been applied to machines making such diversified materials as fibre board, brake- and clutch-lining stocks, automobile panel board, transformer board, and asbestos-cement products. They range in size up to 140 inches long and 50 inches in diameter. The new rolls can be put on machines already in service, replacing those of different construction.



Davis Dam Now in Service

DAVIS DAM, last of the structures planned by the U. S. Bureau of Reclamation to control the lower Colorado River, went into operation officially on January 5, when the first of its five generating units began turning. Seated in his Washington office 2700 miles away, Secretary of the Interior Oscar L. Chapman pressed a telegraph key to inaugurate power production.

To make additional electrical energy available to defense industries on the Pacific Coast as soon as possible, the installation of the first unit was completed three months ahead of schedule. The others will go on the line at the rate of about one each month, and all five are expected to be in service by next July. Each consists of a 62,500-hp. turbine driving a 45,000-kva. generator.

The dam is an earth- and rock-fill structure having an extreme height above the foundation of 200 feet, a basal thickness of 1400 feet, and a crest length of 1600 feet. To build it, the river was diverted through a channel in one abutment. The channel now serves as the powerhouse forebay, and water, under an average head of 120 feet, will be fed from it to the turbines through steel penstocks 22 feet in diameter. Construction was started by a group of contractors headed by the Utah Construction Company on July 19, 1942, halted by the War Production Board in December of that year, and resumed in April, 1946. Storage of water began in January, 1950.

The structure is named for Arthur Powell Davis, who joined the Reclamation Service, forerunner of the Bureau of Reclamation, soon after it was established in 1902. He became its director in 1914 and served in that capacity until 1923. He is generally credited with having inaugurated the Colorado River investigation program that led to the building of Hoover Dam, 1930-35. As early as 1914, he discussed such a dam with Secretary of the Interior Lane. Mr. Davis, who died in 1933, was a nephew of John Wesley Powell, one-armed Civil War veteran who rode down the lower Colorado in 1869 in a chair bolted to the deck of a boat and was the first man to urge that the stream be developed.

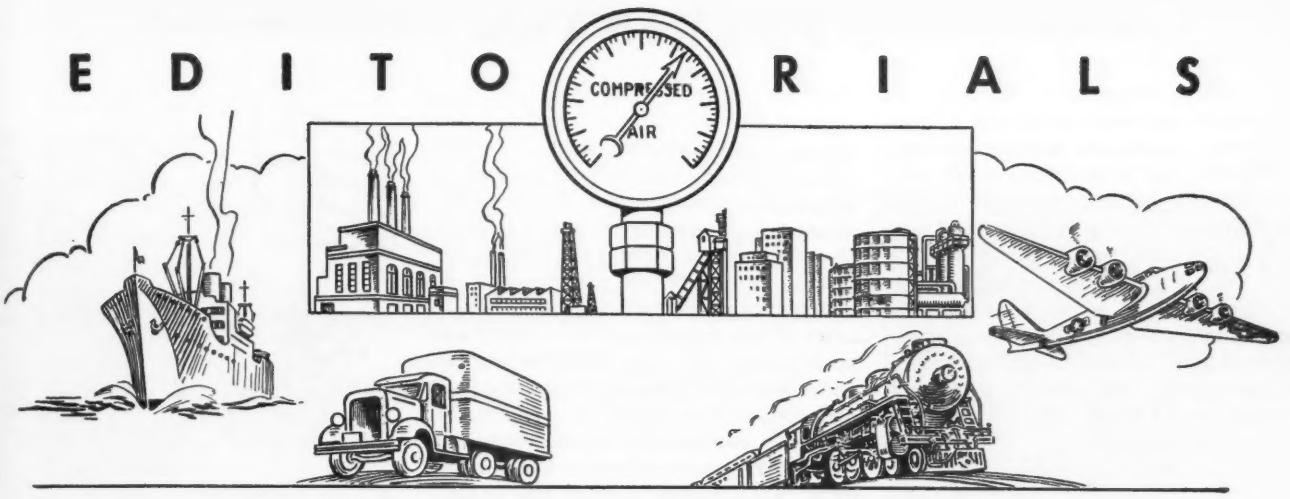
The dam is located in Pyramid Canyon, 34 miles west of Kingman, Ariz., and its ends touch the states of Arizona and Nevada. Its reservoir, at full-pool level, will extend upstream 57 miles to the tailrace of Hoover Dam. It is one of five dams on the lower reaches of the Colorado, beginning with Hoover on the north and ending 300 miles downstream at Laguna. Of these structures, Laguna and Imperial merely divert water to irrigation-system canals. Parker, 88 miles downstream from Davis, is a power producer and also provides a basin from which water is pumped into the aqueduct that delivers it to Metropolitan Water District cities in Southern California.

Aside from generating power, much of which will be used by Arizona farmers to operate water pumps, Davis Dam will regulate the flow of the river below Hoover Dam to insure the desired rate of delivery of the 1,500,000 acre-feet of water apportioned to Mexico annually for irrigation purposes. Construction of the dam was incumbent upon the United States under the terms of its water treaty with Mexico. Including transmission lines and other auxiliary works, the undertaking cost approximately $114,000,000.

POWERHOUSE AND SPILLWAY

Pictured at the top is the powerhouse in the foreground and, behind it, the concrete structure of the forebay from which water will be fed to the turbines through 22-foot-diameter penstocks. The other view shows the downstream face of the spillway, with 9380 cubic feet of water per second being discharged through its three 50x50-foot control gates. The photographs were taken late last November.

EDITORIALS



"DOING SOMETHING"

A MINISTER of Asbury Park, N. J., who was once a miner recently drew some comparisons between drilling rock and saving souls. The miner, he believes, has much the better of it psychologically because at the end of each day he can see that he has accomplished something. The minister, on the other hand, can only keep plugging away and hoping he is getting somewhere. Results are rarely immediately discernible.

In a column of the church paper headed *Minister's Corner*, the Rev. Everett W. Palmer, of the First Methodist Church, wrote:

We are often tempted with discouragement in church work, as most of us well know. It deals with the intangible, its methods are not impressive, its results not immediately seen nor easily measured. It is like the difference between being a gold miner and a Methodist preacher. How often have I thought of that!

In old days I set up a machine and drilled holes six, eight, and ten feet into the face of solid rock. The machine looked like an oversize machine gun, and sounded worse. It roared like a thousand demons, splattered oil and muck on my face and clothes, spouted a gray fog through its exhausts. Drilling steel clattered, wrenches banged. There was no doubt about it, I was doing something. Then at day's end I tore down the equipment, stored it out of harm's way, loaded the holes with dynamite, lighted the fuses and ran for safety. Behind some bulkhead I rocked with the concussion of the blasts. When the last shots had thundered and air hoses had blown out the worst of the powder fumes, I went back to peer through the rock dust and the smoke and look things over. Always it was plain to see that I had done something.

In moments of weakness since, when toiling at some difficult task as a minister, I have wished, 'If only I could set up an Ingersoll-Rand (drill), turn on the power, drill some holes, and then blast.' But no, church work like all work in the realm of ideas, personality, motives, and spiritual resources, requires patience, plus an abundance of faith, hope, and charity. Its methods must be quiet and humble. Its results cannot be quickly seen.

Thoughts similar to some of those just recorded are often expressed by miners and mining men. In fact, they make up what might be called the traditional code of the mining fraternity. Men who extract minerals from the ground take pride in the fact that they are creating new wealth. Not only do they lean on no one else for a livelihood, but they also provide the raw materials that support countless industries with millions of persons on their payrolls. Unquestionably, they are contributing substantially to the well-being of humanity and are fully justified in feeling that they are "doing something." And that is, of course, one of the most satisfying compensations that can be received for honest toil.

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THE RIDDLE OF BRITTLENESS

GLASS is composed essentially of sand, soda, and lime. All are resistant to shock, but when they are processed and combined as glass the product is easily shatterable. The same is true of ceramic tableware. Why does a pane of glass or a china plate break when it is dropped on a hard floor or struck with a hammer? What makes it brittle? Like glass and china, concrete is a combination of natural minerals, but it is less brittle than any of its components. Why the difference?

These are the questions scientists are endeavoring to answer at the Battelle Institute in Columbus, Ohio. Solution of the riddle would be of great practical importance. Ceramics will withstand heat better than common metals, as witness their use for lining blast furnaces and open-hearth furnaces. If their fragility could be overcome they could be used advantageously in jet engines, rockets, and gas turbines.

Brittleness cannot be explained from a scientific standpoint. According to theory, the atomic forces in a ceramic material are stronger than those in metals. If theory held good, hammering a dinner plate would dent or deform the hammer and not the plate. Since the reverse is true, scientists are puzzled. They believe that glass and ceramics are fragile because their structures are not really solid but contain myriads of invisible imperfections, which are termed dislocations or stress concentrators. If a way could be found to eliminate these flaws, the strength and toughness of these substances might be increased a thousandfold.

In certain forms, ceramic materials approach their theoretical strength. For example, a filament of freshly drawn glass is stronger than a similar thread of steel. Just why larger sections of glass are proportionately weaker is hard to explain. The investigation of brittleness may open some interesting avenues of exploration. It has been suggested, for instance, that if the problem could be solved we might, conceivably, change our ways of doing many things. A better knowledge of the fundamentals of breakage could affect the design of rock drills and of all equipment for crushing rock and ores.

Up to now, our research has taken a different course. Designers of rock drills have been concerned with finding out why parts of their machines break under continual impact. Always the emphasis has been upon learning more about the tool and improving it. Nobody has made any great effort to study rocks from the standpoint of ascertaining why they are hard to disrupt. It is known of course, that some rocks are easier to drill than others, and they are not necessarily the softer ones.

The action of a drill is to break off minute fragments, in other words, to shatter the material. Obviously, then, if we knew more about the shatterability of different rocks, the problem of drilling or crushing them would be made easier. The scientists at Battelle Institute don't expect to come up with the complete answer for a long time—in fact, they may never find it. However, their pioneering should stimulate similar investigations by industrial research men in the fields concerned. From these collective efforts much beneficial knowledge might be gained. The whole situation seems to be fraught with intriguing possibilities.

This and That

Turkeys for Miners

Many firms give their employees turkeys at Christmastime, but the generosity seldom reaches the proportions exhibited by the Consolidated Mining & Smelting Company of Trail, British Columbia. For the 1950 Yuletide, the concern ordered approximately 8000 birds, averaging 14 pounds apiece live weight and aggregating more than 55 tons. All active employees, pensioners, and widows of former workers shared in the distribution.

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Liquefied Gas Stored Underground

The practice of storing liquefied petroleum gases such as propane and butane in caverns hollowed out of underground salt formations may become common in western Texas. To determine the practicability of the idea, The Sid Richardson Gasoline Company, of Fort Worth, Tex., made such a cavern in Winkler County. The greater part of western Texas is underlain by a salt bed of varying depth and thickness. In the area selected, it is around 600 feet thick and its top is about 1165 feet below the surface.

The storage chamber was formed by the simple procedure of putting down a hole with a standard oil-well drilling rig to a point near the bottom of the formation and then circulating water to dissolve enough salt to create a reservoir of the desired size. The pumping capacity was gradually increased until it reached 7000 gpm., and the extent of the excavation was calculated by keeping a record of the amount of water injected and the salt concentration of the return stream.

When the opening was large enough, liquid propane was pumped into it to displace the brine. This storage chamber has now been used five times. The first time it was emptied only 95 percent of the propane was recovered, but in subsequent tests this figure increased to more than 99 percent. Except for a slight addition of moisture, the propane was unaffected by contact with the salt. Reservoirs of this type in service today have an aggregate capacity of 50,000 barrels, and experience indicates that they cost about $2.50 per barrel of capacity, or about one-seventh the amount required to build steel tanks above ground. Aside from this favorable factor, the underground facilities need no steel other than for casing and tubing, and no surface space. They also eliminate aboveground operational hazards and provide bombproof protection for the products.

"Better open your tent flaps . . . the pipe line goes right through."

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Rubber Heel Facts

One of the minor uncertainties of the war situation is how Americans will fare in getting rubber heels in the days ahead. Currently, three out of every four pairs of shoes worn in this country are provided with them, they are on 65 percent of all the new shoes, and 85 percent of the repair jobs specify them. Rubber manufacturers attribute their popularity to the fact that they outwear competitive products by as much as four to one, but our guess is that people also prefer them because they reduce the jar of walking and guard against slipping on ice and snow and smooth floors.

Be that as it may, the future of rubber heels is in doubt, and not primarily because of an imminent rubber shortage. Remember the old story about a battle that was lost for lack of a nail with which to shoe a horse? Something like that is now threatening to put us back on leather or composition heels. It seems that the small steel washerlike disks that are necessary to hold the nails inside the heels are in short supply, and the Government is doing nothing about it.

Two companies supply most of these washers to the nation's 100 shoe manufacturers and 60,000 shoe-repair shops. They normally consume around 250 tons of sheet steel a month but have been cut back to the point where they are operating only two days some weeks. Thus far, the National Production Authority in Washington hasn't paid much attention to their requests for more steel. Meanwhile, the country is in danger of becoming run down at the heels. One of the big rubber companies, apparently unaware of the washer situation, recently issued a forecast that more people than ever will walk on rubber heels in 1951. It estimates that 412 million rubber heels and 204 million rubber soles will be produced during the coming twelve months.

"It's just the boss letting off pressure."

★ ★ ★

Tires Last Long

R. G. LeTourneau, Inc., of Peoria, Ill., recently did some research on the durability of large pneumatic tires used on the heavy earth-moving machinery it builds. This took the form of a contest, conducted through a company publication, with prizes for those who reported the greatest number of hours compiled by tires still in service. Contestants were required to back up their statements with actual records or estimates by the owners of the vehicles concerned.

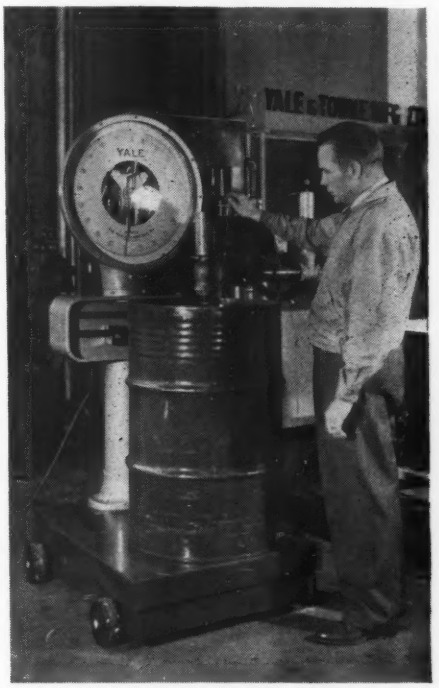
Two types of machines were involved: the Tournapull and the carry-all scraper, with prizes in each class. In the first category, an operator in Trinidad, South America, reported a 21x24-inch tire that had worked 10,750 hours. In the carry-all group, this figure was far eclipsed by a 24x32-inch tire in Canton, Ohio, that had amassed 25,000 hours of service.

LeTourneau's interest in the matter stems partly from the fact that it introduced pneumatic tires to the earth-moving industry and has always advocated their use in preference to track-type tractors. Until 1932, its scrapers were provided with steel disk wheels. In that year, on a job in the Imperial Valley desert of California, the equipment often became stuck when sand piled up ahead of the flat wheels. Reluctantly, the contractor permitted the company to try pneumatic tires on one scraper. They reduced resistance to rolling so much that the operating speed and, consequently, the work done, was doubled. All scrapers built by LeTourneau thereafter were equipped with rubber tires, and eventually other manufacturers of such machines also adopted them.

Air-Controlled Drum Filler Measures Fluid Content

FOR filling drums of 5-gallon capacity and up with liquids of low or high viscosity to meet the requirements of State Sealers of Weights and Measures, Yale & Towne has produced a pneumatic device that is used in conjunction with any of its standard Load King scales with tare and capacity beams. The unit is mounted on one side of the scale, as the accompanying illustration shows, and is complete with valves and piping for connection to a shop air line.

Filling proceeds quickly, as follows: With a container weighing, say, 50 pounds standing on the scale platform, the operator moves the poise of the air-actuated tare beam until the indicator on the scale's dial points to the net amount of liquid to be measured into the drum. If it is to be 150 pounds, then the needle is set there, but the poise itself will actually indicate 200 pounds, the difference between the two figures being the weight of the container. When the latter has been charged and removed from the platform the dial registers the gross weight.



MEASURING DEVICE IN USE

The unit is shown with the adjustable valve assembly lowered onto the bunghole of a large drum in filling position on the scale platform. The operator has his hand on the lever by which he moves the tare-beam poise until the dial pointer indicates the amount (net weight) of the fluid to be measured into the container. Typical liquids being handled include oils, paints, varnishes, chemicals, and foods such as syrups.

With everything set, a valve assembly, that is lowered and lifted pneumatically by means of a lever, is brought to rest on the drum's bunghole. Next a push button is pressed to start the flow, which stops automatically when the predetermined weight is reached. Both the flow and cut-off valves are adjustable to regulate the filling speed, which depends upon the fluid being dispensed. The valve assembly also is adjustable to permit the use of containers of different heights. To facilitate the handling of drums, a roller-conveyor section can be mounted on the scale platform.

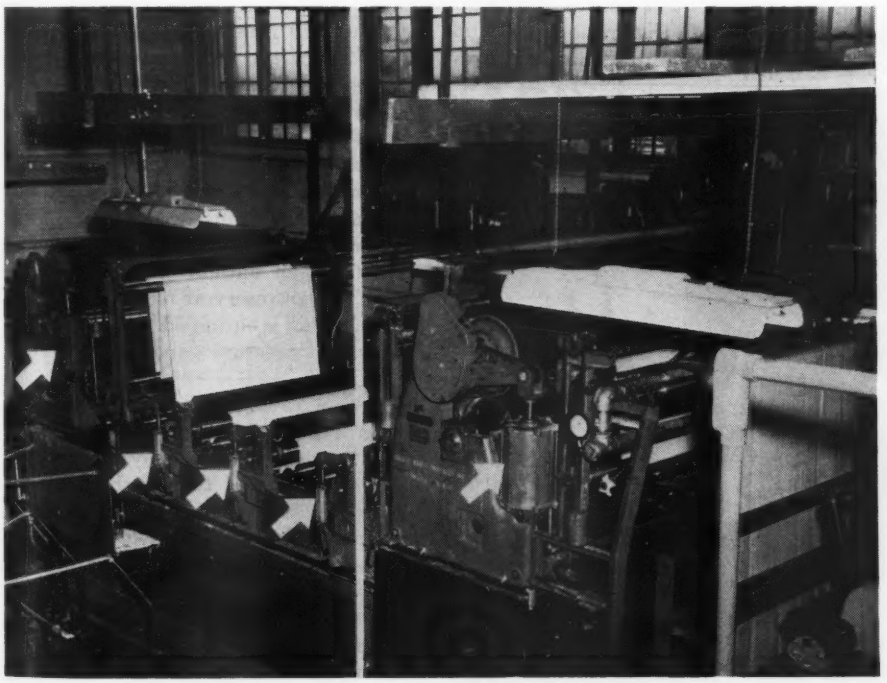
Without wastage, the Yale air-controlled device will, it is claimed, fill a 54-gallon container with SAE 30 lube oil at a temperature of 95°F. in 49 seconds and dispense 442 pounds of it with an accuracy to within 6 ounces. Being powered entirely by compressed air at 80-100 psi., the work is done with safety under the most hazardous operating conditions.

Carbonizing Tank of Acid-Resistant Stainless Steel

AMONG the numerous finishing operations to which wool cloth is subjected in the course of manufacture is carbonizing—a method by which vegetable matter is removed from the textile by treating it with sulphuric or hydrochloric acid. The work is done by running the material first through an acid soaking tank where it passes alternately through a succession of immersion and squeeze rolls, then through a drier to take out the moisture, and, finally, through a baker where the vegetable matter is converted into carbon.

Exposed as they continually are to the attack of these highly corrosive acids, the soaking tubs are usually lined with rubber, which can be replaced when necessary. To eliminate this, and to provide equipment that will have a long service life, Riggs & Lombard, Inc., has recently put into production a carbonizing tank built entirely of SMO stainless steel. It has three sets of standard rubber-covered squeeze rolls, each of which is equipped with two air cylinders that both lift and apply pressure, which is adjustable from zero to what is considered to be the optimum for rolls of a certain length and size.

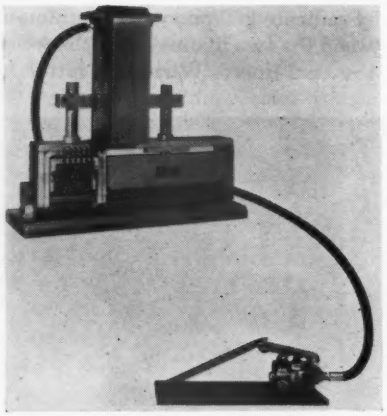
"One of the most important advantages of the use of air in installations such as these," says the manufacturer, "is that the pressure on the cloth is the same from side to side." The controls for the pneumatic cylinders are on a single conveniently located panel. Compressed air also serves to agitate the acid bath in order to make sure of uniform carbonization.



INSTALLATION VIEW

Our picture shows the wet end of the carbonizing range starting, from left to right, with a wet-out tank, a heavy-duty squeeze-roll extractor, the acid soaking tank, and another squeeze-roll extractor. Indicated by arrows are five air cylinders, three on the carbonizing tank and one each on the extractors. These are duplicated on the other side, making five sets of two each. All serve the same purpose—either to lift the top roll or to apply whatever pressure the cloth being treated may require. The newest carbonizing tank has an overhead frame carrying a series of transverse sky rolls over which the material passes as it comes from the squeeze rolls. The purpose of these carriers is to lengthen the soaking period.

Industrial Notes



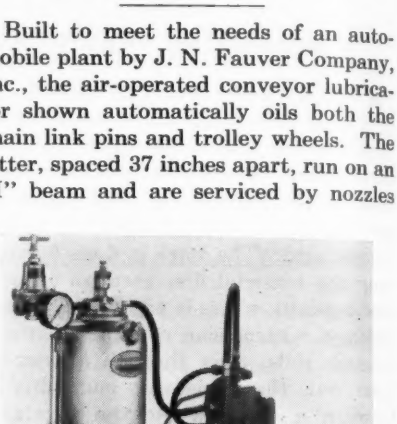
Heavy kraft-paper bags for packaging bulk materials can be marked at the point of manufacture by a time-saving machine built by Wm. A. Force & Company, Inc. The device is operated by compressed air at 30 to 100 psi., and is controlled by a foot valve which causes an imprinting head to descend and number, code, date, or otherwise stamp the bags, which are hand fed and withdrawn. Release of the pedal allows the head to return to the "off" position. Interchangeable ½-, ¾-, and 1-inch rubber type is used. The machine can be set to work in consecutive, duplicate, or repeat order and permits carrying one line of bags in stock to be marked as desired.

Underwriters' Laboratories, Inc., lists a new gasoline- and oil-resistant conductor for wiring in places where petroleum products may cause ordinary conductors to deteriorate. Named Geotrol, the wire is insulated with a vinyl compound and sheathed in a jacket that, being lighter than the usual lead covering, saves cost and installation time. It is available in white, black, red, blue, green, yellow, and orange and with solid conductors in sizes 14, 12, and 10 American wire gauge.

The Research Laboratory of General Electric Company has compounded a sealing liquid for use with metals that penetrates tiny cracks and solidifies quickly when no longer exposed to air. It is claimed that a joint made by lightly coating two strips with it and clamping them together will support 10 pounds after a lapse of ten minutes. The product is called Anaerobic Permafil and can be applied in place of locknuts to hold nuts tight on bolts, to thread pipe joints, to make castings airtight, and for many other purposes.

By the use of its new mixer, says the American Well Works, one or more chemicals or gases in solution can be blended quickly and evenly with water, sewage, or industrial wastes without the need of tanks. Known as Homomix, the unit forms part of the influent piping and does the work in one or more stages. For each of the latter there is a diffusing impeller driven by a continuous shaft direct connected to the prime mover and rotating in a blending chamber provided with a tube through which the solution is introduced. A transparent port in the chamber wall, which can be opened for the examination of the rotating element, enables the operator to watch the mixing action. The equipment can be installed in a vertical, horizontal, or inclined position and is made in single or multiple types with 6- to 24-inch inlet and outlet openings.

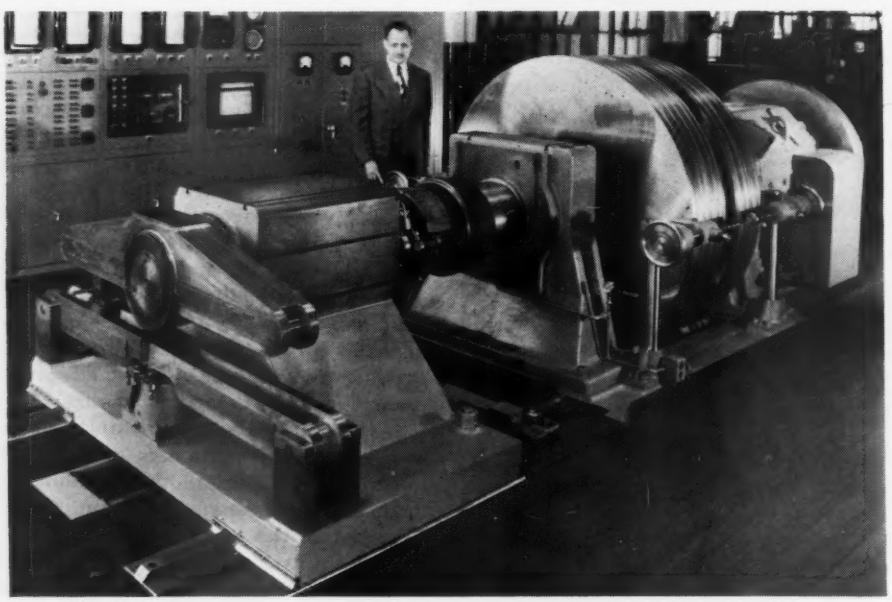
Built to meet the needs of an automobile plant by J. N. Fauver Company, Inc., the air-operated conveyor lubricator shown automatically oils both the chain link pins and trolley wheels. The latter, spaced 37 inches apart, run on an "I" beam and are serviced by nozzles



attached to the tripping mechanism. They direct the oil straight downward at the point where the wheel rotates against the hub at the end of the pin bearing. This is necessary because there are no fittings on the conveyor, which travels at a speed of 14 to 20 feet per minute. The chain link pins are closely spaced and are lubricated by aid of a manifold with fourteen outlets on 2⅝-inch centers. The oil reservoir has a capacity of 2 gallons and is equipped with an air regulator and pressure gauge.

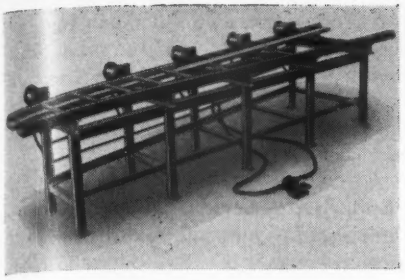
Serving as a flexible connection between pump and pipe line in water, boiler, or air-conditioning system, Soundzorber is designed to absorb noise and vibration. It consists of a specially constructed rubber pipe with standard flanges embedded in rubber to prevent metal-to-metal contact and is bolted in place without gaskets. Made by Finn & Company, it is available in sizes for ½- to 14-inch-diameter pipe, for working pressures up to 250 psi. with a 5-1 safety factor, and for a maximum temperature of 250°F.

The Union Tool Corporation, which specializes in the manufacture of woodworking equipment, has announced an addition to its line of air-operated clamps. The new unit is designed to



SUPERTESTER FOR BRAKING MATERIALS

On this huge dynamometer, largest of its kind, Raybestos-Manhattan engineers subject brake linings, blocks, and clutch facings to all conditions they will be called upon to meet in actual service. When fully loaded, its action is equal to that of the rear-axle brake of a truck carrying 60 tons on three axles at all speeds from a creeping pace to 200 miles per hour. All types of brakes (air, vacuum, hydraulic, electric, mechanical) can be tested. The machine is designed to handle brake assemblies for both automotive and railroad equipment in sizes now used and likely to be used in the foreseeable future.



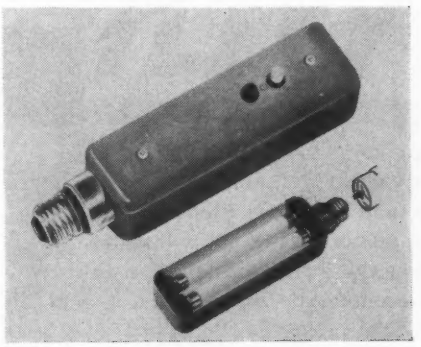
facilitate the assembly of ladders and consists of a sturdy retaining frame and hand- or foot-controlled air cylinders. All parts are positioned in the frame and firmly pressed together simultaneously, pressure on the rails being applied gradually so rungs can be aligned carefully with holes. The basic clamp is suitable for ladders up to 14 feet long and may be extended by adding a length complete with pneumatic cylinder.

Ferrous particles entrained in liquids, slurries, and slips flowing through pipe lines can, it is claimed, be removed by a hump-shaped nonelectric magnetic separator made by Eriez Manufacturing Company. The unit has baffles which direct the fluid 30 degrees from the horizontal so that two plate-type magnets on opposite sides of the hump can set up a magnetic barrier in tandem. Entrapped iron is dislodged from recesses provided by stepped pole plates, and pressure-tight hand holes permit cleaning the magnet faces. The flow-interrupting separator is designed for use with pipe lines ranging in diameter from 6 to 20 inches and is said to function satisfactorily with pressures up to 45 psi. and with materials flowing at the rate of 50-250 cfm., which depends upon their consistency.

Heavy-walled plastic piping resistant to bursting pressures up to 260 psi. is being manufactured by the Carlon Products Corporation in 2-, 2½-, 3-, 4-, and 6-inch diameters. That factor, combined with flexibility, light weight, and resistance to rot, rust, and electrolytic corrosion, makes it suitable for many purposes within a temperature range of minus 70 to plus 140°F. Molded plastic fittings are provided for plastic-to-plastic or plastic-to-metal connections, and a lengthwise red stripe permits identification.

By a recent ruling, all equipment shipped to Europe under the Economic Cooperation Administration program must be plainly marked with the E.C.A. emblem to indicate that it is of U.S.A. origin. The emblem is in the form of a shield with four stars arranged horizontally in a blue field and with thirteen vertical red and white stripes. It can be obtained in quantity in Decal transfers made by The Meyercord Company of Chicago, Ill. Imprinted on them in anyone of thirteen languages is the inscription: "For European Recovery Supplied by the United States of America."

Fluorescent lamps that screw into any standard light socket are the newest thing in the field of illumination. A product of Stocker & Yale and trade-named Lite-Mite, it has two 4-watt fluorescent bulbs in a 2x6-inch rotating aluminum shade or reflector finished in white enamel on the inside and light-gray on

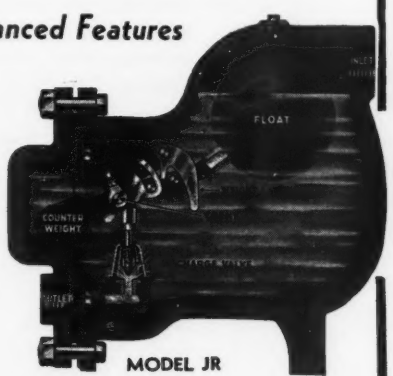


the outside. The lamp is recommended for home, office, laboratory, and factory use, expecially for close work because of its cool light and intense illumination (up to 500 foot-candles, it is claimed, at a working distance of 3 to 5 inches). Under normal conditions, it has a rated average life of 7500 hours, or 3½ years.

Nicholson Air Traps Assure

POSITIVE DRAINAGE OF AFTERCOOLERS

by 2 Advanced Features



1) Positive Fluid Seal Over Discharge Valve—As a result of this feature Nicholson traps are increasingly specified wherever loss of air is a problem in drainage of aftercoolers, intercoolers, separators, receivers, etc.

2) Extra Large Discharge Capacity—Valve opens wide instantaneously to discharge water, oil and dirt, after which it closes tight—instantaneously.

OTHER TROUBLE-PROOF FEATURES Non-wire drawing; not dependent on float to raise valve; of stainless steel where it counts, to prevent corrosion; rugged, for unavoidable abuse. 3 types for press. to 1500 lbs.

Catalog 250 or see Sweet's

W. H. NICHOLSON & CO. 180 OREGON STREET WILKES-BARRE, PA.

Valves ★ Traps ★ Steam Specialties

"MINE KING"

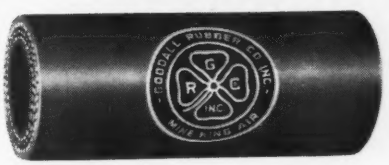
The Answer to

SAFE, LOW-COST

Hose Service

"Standard of Quality"

Sizes ½", ¾" and 1". Double and Triple Cord. Max. Lengths of 500'.



Use of "MINE KING" Air Hose assures important economies in drilling operations, regardless of conditions.

Its tougher, more durable construction keeps it on the job longer—a saving in hose replacement costs.

Extreme flexibility provides easier handling and facilitates drilling in tight spots and coiling for transport.

Availability in extra long lengths reduces the need for intermediate connections to an absolute minimum—fewer couplings required—less time for setting up the lines.

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GENERAL OFFICES, MILLS and EXPORT DIVISION, TRENTON, N. J.

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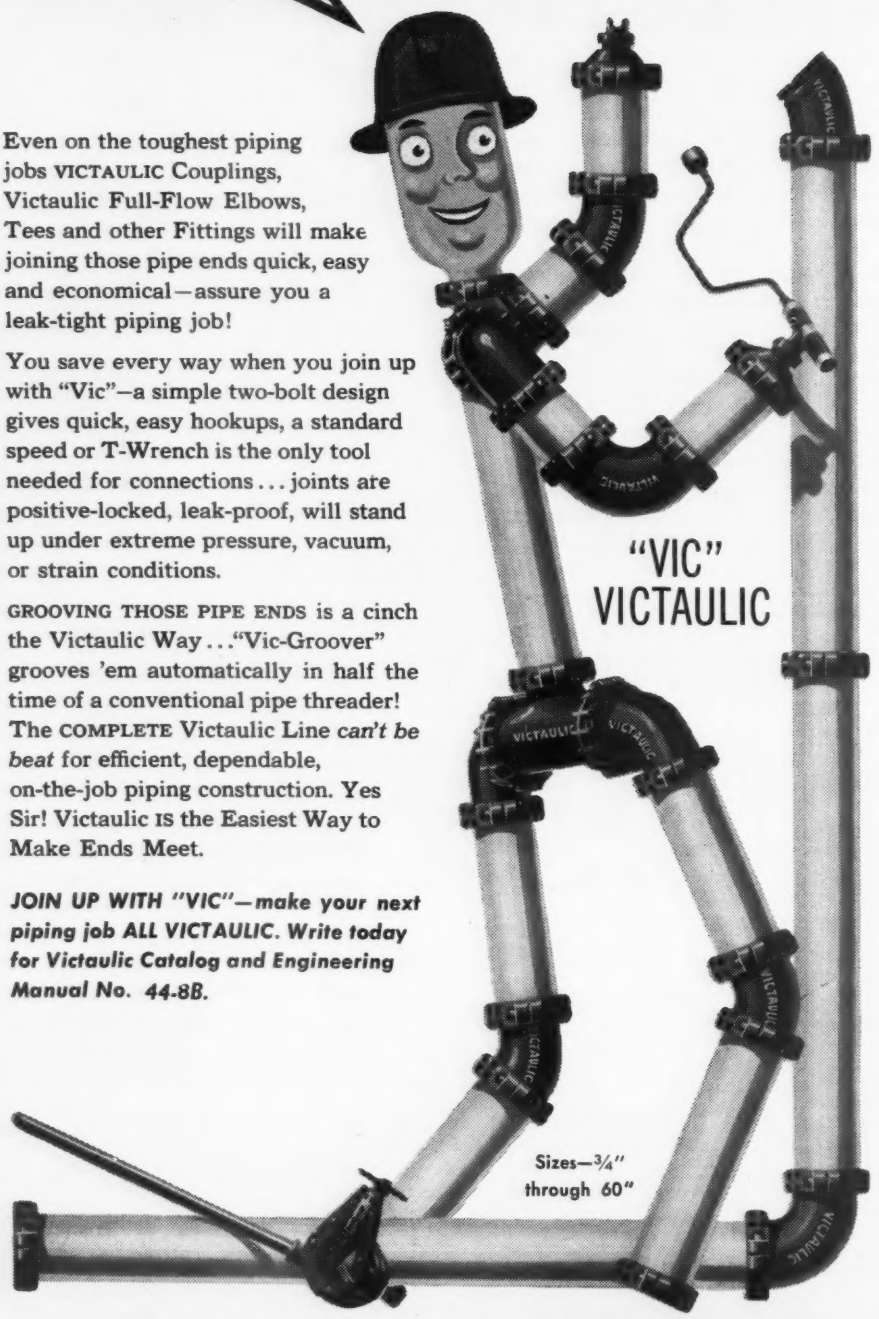
THE EASIEST WAY TO MAKE ENDS MEET



Even on the toughest piping jobs VICTAULIC Couplings, Victaulic Full-Flow Elbows, Tees and other Fittings will make joining those pipe ends quick, easy and economical—assure you a leak-tight piping job!

You save every way when you join up with "Vic"—a simple two-bolt design gives quick, easy hookups, a standard speed or T-Wrench is the only tool needed for connections . . . joints are positive-locked, leak-proof, will stand up under extreme pressure, vacuum, or strain conditions.

GROOVING THOSE PIPE ENDS is a cinch the Victaulic Way . . . "Vic-Groover" grooves 'em automatically in half the time of a conventional pipe threader! The COMPLETE Victaulic Line *can't be beat* for efficient, dependable, on-the-job piping construction. Yes Sir! Victaulic IS the Easiest Way to Make Ends Meet.

JOIN UP WITH "VIC"—make your next piping job ALL VICTAULIC. Write today for Victaulic Catalog and Engineering Manual No. 44-8B.

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27TH VICTAULIC YEAR

The easiest way to make ends meet
VICTAULIC
PIPE COUPLINGS AND FITTINGS

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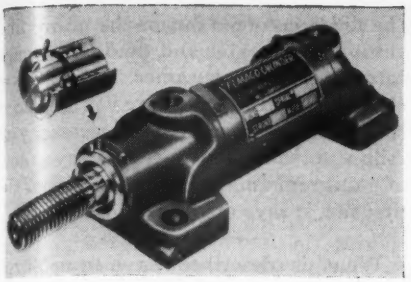
Two models are available: one for end mounting, as shown, and the other with a centrally located base. All fixtures are provided with white bulbs, but others in warm-white, daylight, blue, green, and black are available.

Endurite, a new wire for electric circuits, is said to meet all building requirements because it is rated for use in both dry and wet areas. Combines excellent moisture-resisting properties with greater than usual carrying capacity and higher permissible operating temperatures, according to the manufacturer, Crescent Insulated Wire & Cable Company.

By the use of a new intensifier designed and in production by The Cooper-Bessemer Corporation, the usual procedure of transporting boilers, compressor cylinders, piping, etc., for pressure testing is reversed. Compact and mounted

on pneumatic-tired wheels, the unit can be taken to the job and made ready for operation in less than five minutes, it is claimed. It is connected by high-pressure tubing with a ¾-inch coupling to a source of air at 90 psi., which is built up by means of oil to a maximum pressure of 23,000 psi. The equipment to be tested is filled with water and is attached to the high-pressure outlet at the bottom of the intensifier. Next, the latter's oil inlet is connected to the supply line, the air connection is made, and the valve is opened. The test pressure is set by a regulator and is indicated on an easy-to-read dial. Any inexpensive grade of fuel oil is suitable for the work. The intensifier can also be used for destruction tests in laboratories.

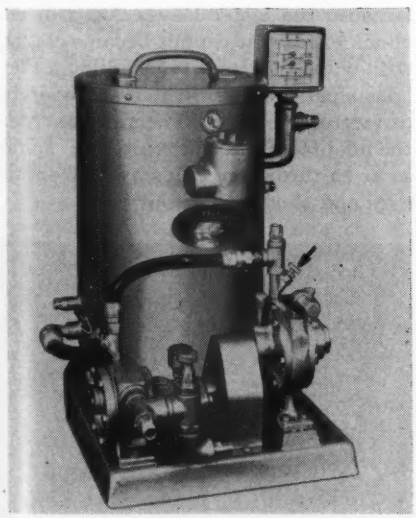
Under the name of Pemaco E-Z-Pak, the Petch Manufacturing Company is marketing a self-contained, cartridge-type gland for air and hydraulic cylinders. It is designed to comply with J. I. C. standards, and consists of bronze bushings, a low-friction ram seal, and a seal-guard ram scraper. There is a bushing on each side of the packing rings, an arrangement that provides ample bear-



ing surface and maximum packing life. The packing is of the self-adjusting metallic type and is further protected by the bronze scraper, which excludes all external abrasives. Replacement of the gland can be accomplished without dismantling the cylinder and, in most cases, without removing the latter from the machine it serves. This is an important factor because it reduces down time.

Applied much like wallpaper, Texad is used in place of steel plates as a covering for boilers and industrial furnaces. Made by Bigelow-Liptak Corporation of lightweight canvas, it is coated with a plasticized synthetic resin which serves as the adhesive and may be finished in aluminum or colored paints. The protective material is weatherproof and makes the insulating cement more airtight by sealing shrinkage cracks and pores.

By means of a blowback attachment designed by Bede Products Inc. for use with its spray-paint heater, flushing of supply lines and color changes are accomplished quickly, it is claimed, without wastage. Compressed air, which is used to do the painting, also does the cleaning. It is diverted into the system by shutting off the air motor and pump by a valve on the inlet side of the motor and opening a second valve. Under the pressure of the air admitted by the latter,



HEATER WITH BLOWBACK

The attachment consists of a hose, valves, and fittings and connects the air motor (right) with the fluid pump (left). The valves by which the air is diverted into the system are indicated by arrows.

POWER *plus* PORTABILITY

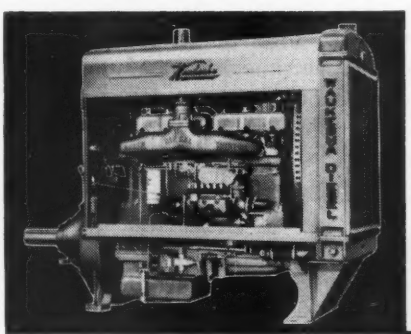
WAUKESHA *Diesel* POWER

● Quickly moved, and easily set up, to turn out a smooth uninterrupted flow of ¾-inch aggregate — 100-125 cu. yds. an hour! This portable crushing, screening, loading plant is built by Highway Machinery Co., Waukesha, Wis. Its design emphasizes portability *and* power—Waukesha *Diesel* Power for capacity, dependability and low-cost operation.

This plant has a special 10½" x 36" Dual Jaw Primary Crusher, with Roll Secondary Crusher, 4' x 8' Triple Deck Screen, feeder, drum elevator, and conveyors—and all equipment is powered by the Model 148-DKU Waukesha Diesel. Yet it handles every load demand eagerly and easily with power to spare . . . burning its fuel cleanly, without smoking on the job. Economical, too . . . and easy to start. And neither flying dust nor dirt deter it in the least. Easy to understand and operate, this Waukesha Diesel is a contractor's engine.

Send for Bulletin 1414.

108



Model 148-DKU WAUKESHA DIESEL — Six cylinders, 5¼-in. x 6-in., 779 cu. in. displacement, 180 hp. maximum.

WAUKESHA MOTOR COMPANY
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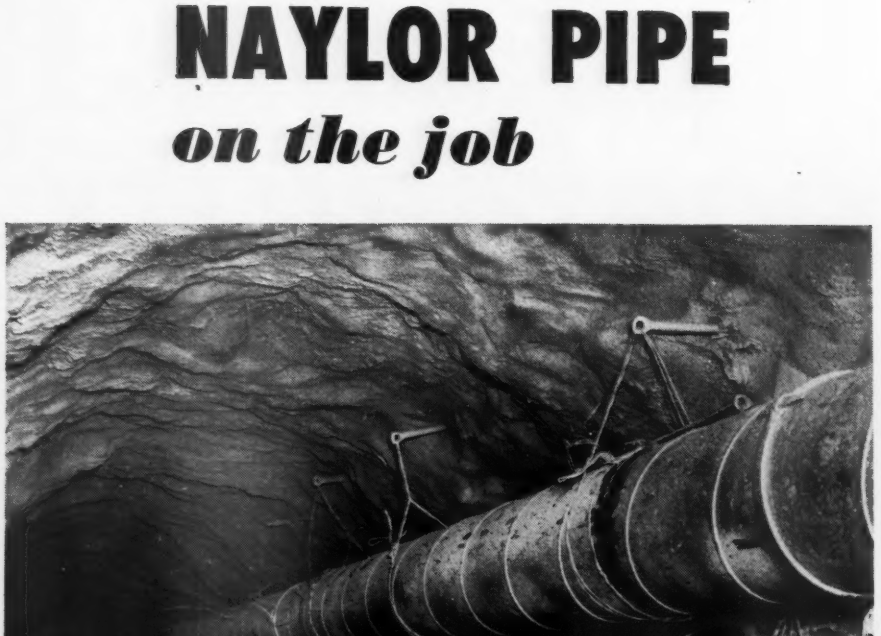
NEW YORK • TULSA • LOS ANGELES

You'll breathe easier with NAYLOR PIPE *on the job*



You can always depend on Naylor pipe for the vital job of supplying fresh air underground.

This distinctive lightweight pipe is built with an exclusive Lockseam Spiralweld structure which permits use of lighter gauge material without sacrifice of performance. The Naylor structure creates a reinforcing truss which assures additional collapse strength and enables Naylor pipe to be used on push-pull ventilating jobs that ordinary lightweight pipe can not handle.

Add to this the advantages of Naylor's one-piece Wedge-Lock Coupling and you'll have a line that hugs the wall, is always safe, accessible and dependable.

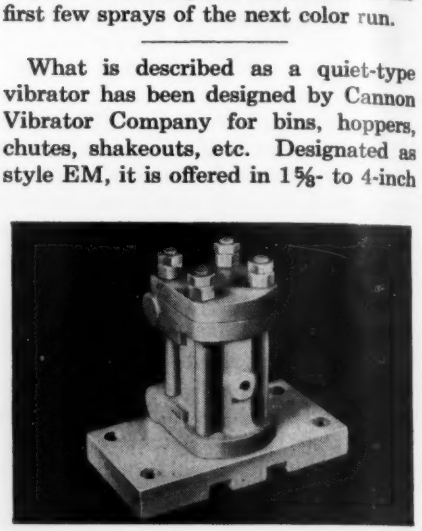
Sizes from 4" to 30" in diameter...thickness from 14 to 7 gauge...all types of fittings, connections and fabrications. Write for Bulletin 507.

NAYLOR PIPE

Naylor Pipe Company, 1245 E. 92nd St., Chicago 19, Ill.
New York Office, 350 Madison Avenue, New York 17, N.Y.

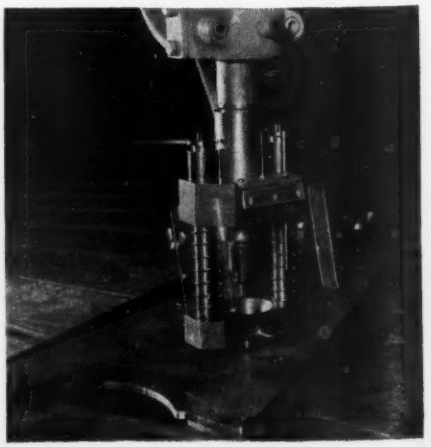
the finish is forced out of the pump and through the heater and fluid hoses back into the original container. According to the manufacturer, flushing is often done so thoroughly that it is unnecessary to follow up with a solvent, and any traces of paint remaining are removed with the first few sprays of the next color run.

What is described as a quiet-type vibrator has been designed by Cannon Vibrator Company for bins, hoppers, chutes, shakeouts, etc. Designated as style EM, it is offered in 1⅝- to 4-inch



sizes which are interchangeable with bolted units. According to the manufacturer, the new line permits the use of a heavier piston with a longer stroke than is normally permissible and operates without the usual noise because there is no impact of the piston at each end—no pounding of metal on metal. Breakage of bolts and end plates is therefore virtually eliminated.

By discarding the sleeve adaptor on its high-speed drill presses for a new-type developed by it, The Glenn L. Martin Company can now use drills right down to the shank, thus avoiding frequent replacement. Drills need only regrinding, it is claimed, and can be changed without removing the adaptor. Because the latter leaves the drill and chuck exposed it cannot become clogged with chips and permits installing a Plexiglas shield through which the operator can watch the work. The air tube enters the adaptor from the rear and spirals so as to throw the chips away from the eyes and thus avoid injury.



Books and Industrial Literature

Despite accelerated production and extensive use of untrained personnel, lost-time injuries and property damage in welding and cutting operations were held at low levels during the last war period by the publication of an American Standard on Safety. With industrial output again increasing, this favorable experience has prompted the American Welding Society to issue a new standard, *Safety in Electric and Gas Welding and Cutting Operations*. It was prepared under the procedures of the American Standards Association by a committee that included representatives of welding and safety engineers, equipment manufacturers, insurance and labor organizations, and government labor agencies. It embodies regulations designed to insure safe installation and operation of equipment for all arc, gas, and resistance welding processes. Copies are available at 50 cents each from the American Welding Society, 33 W. 39th Street, New York 18, N. Y., or from the American Standards Association, Inc., 70 E. 45th Street, New York 17, N. Y.

Safety belts for industrial workers ranging from structural steel riggers to pole linemen are described in Bulletin CF-26 issued by Mine Safety Appliances Company, Braddock, Thomas, and Meade Streets, Pittsburgh 8, Pa.

Cochrane Corporation, 17th and Allegheny Avenue, Philadelphia 32, Pa., has a new booklet, No. 4505, that describes a zeolite water softener for small boilers such as are used in laundries, hospitals, apartment buildings, and small industrial plants.

A multipurpose electromagnet developed by Arthur D. Little, Inc., in conjunction with Prof. Francis Bitter of Massachusetts Institute of Technology, is described in a folder, ADL Magnet, available from the concern, Cambridge 42, Mass. Designed for producing high-flux-density magnetic fields, the new 4000-pound device is reported to be more powerful than others weighing from 15 to 50 times more.

The 1950-51 edition of *Chemical Engineering Catalog* is ready for distribution by Reinhold Publishing Corporation, 330 W. 42nd Street, New York 18, N.Y. Inaugurated in 1915 by the American Institute of Chemical Engineers, it presents condensed data on equipment, machinery, and raw materials for industries that use chemical processes of manufacture. It is cross-indexed for easy reference.

A new bulletin describes Electric Machinery Manufacturing Company's line of "packaged" generators that deliver electric power at constant voltage without accessory switchboard equipment. The 16-page booklet explains these machines in detail and contains electrical information, charts, graphs, and other illustrations to aid in selecting and applying them. Copies of the bulletin, No. 2100-PRD-202, may be obtained from the company. Address Minneapolis 13, Minn.

A pamphlet issued by the National Fire Protection Association dispels the common belief that "fireproof" buildings are immune to serious fires. It reveals that 764 lives have been lost and $25,000,000 damage done since 1940 by 32 fires in such structures. The illustrated study is designed to make builders more aware of what steps must be taken to make structures fire-safe. Copies of the pamphlet are obtainable at 50 cents each from the association at 60 Batterymarch Street, Boston 10, Mass.

Bulletin No. 507, issued by Naylor Pipe Company, 1230 E. 92nd Street, Chicago 19, Ill., is a ready reference source of information on Naylor Lockseam spiralweld steel pipe and fittings. It outlines typical applications, gives collapse pressures of the various sizes, and illustrates procedures for making up joints with different types of connectors.

Zippers like those put on clothing are now combined with rubber to effect seals against gases and liquids in various applications. They serve to produce airtight closures on ailerons, rudders, and flaps of military airplanes, as well as pressure ducting systems. Cases for cameras and various instruments can also be made watertight by means of them. An industrial use is the joining of diaphragms between cars on streamlined railroad trains. The devices are described in a bulletin, *Pressure-Sealing Zippers*, issued by The B.F. Goodrich Company, Akron, Ohio.

The six different types of derricks made by American Hoist & Derrick Company, St. Paul 1, Minn., are described in a new catalogue, No. 200-D-3, obtainable from its advertising department. Specifications, outline drawings, and full-page operating pictures are included for each type. A handy diagram assists users in determining the boom length required to lift a given load under varying height conditions and at varying distances from the center mast. The company also has a new 24-page brochure containing pictures of its revolver cranes now being used in placing concrete in twelve large dams.

NOW... Get Cleaner, Dryer Compressed Air Automatically

Here's the *proved* continuous, automatic control of moisture, oil, rust, dirt and other contaminants in air lines, tanks, after-coolers—anywhere compressed air is used.

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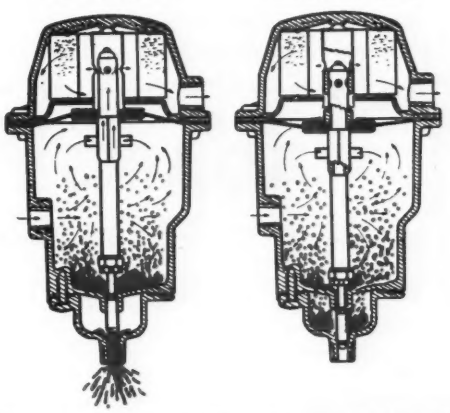

The Wilkerson Automatic Diaphragm Actuated Valve has one moving part; is strongly constructed of corrosion resistant materials. The double O-ring seal gives more efficient operation *without loss of air;* eliminates pressure surge; holds pressure drop to a minimum; assures longer, trouble-free life.

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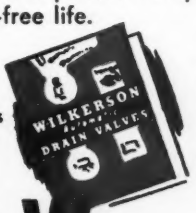

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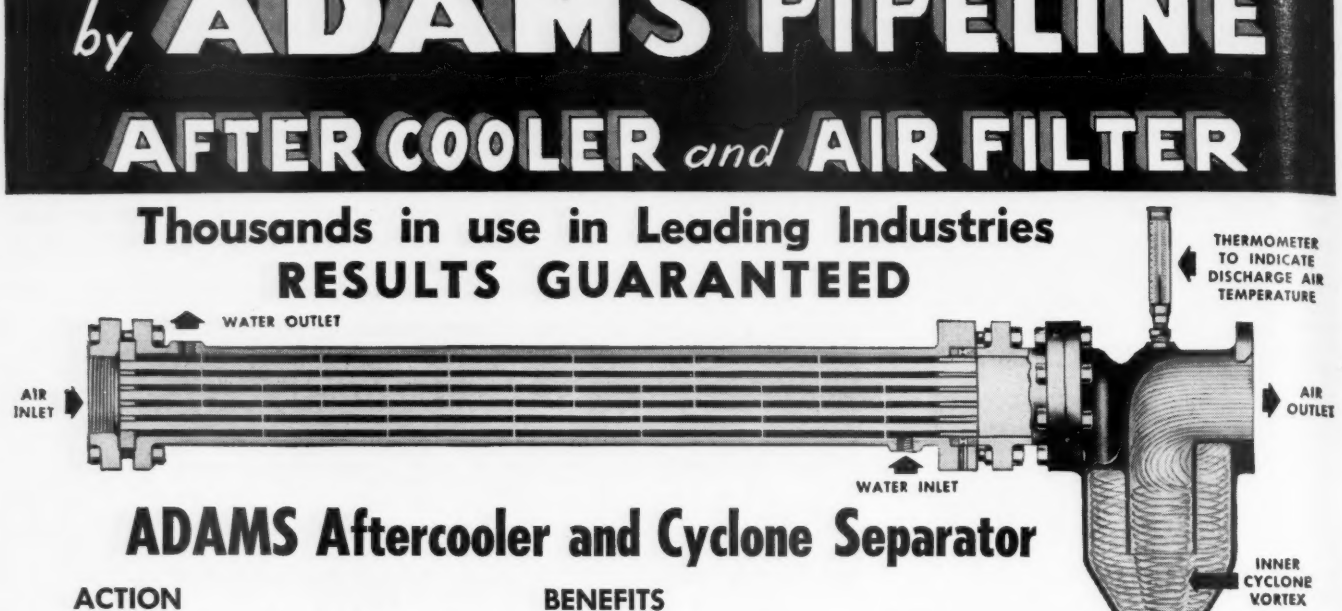

ADAMS Aftercooler and Cyclone Separator

ACTION

- Cools compressed air to within a few degrees of cooling water
- Through this cooling, vaporized water and oil are condensed — and completely removed by Cyclone Separator

BENEFITS

- The dry, clean air prevents failing of instruments
- Reduces wear and tear on air tools and pneumatic machinery
- Prevents freezing pipes in winter
- Prevents rust and pipe scale in distribution lines

Easy to install, no foundation required

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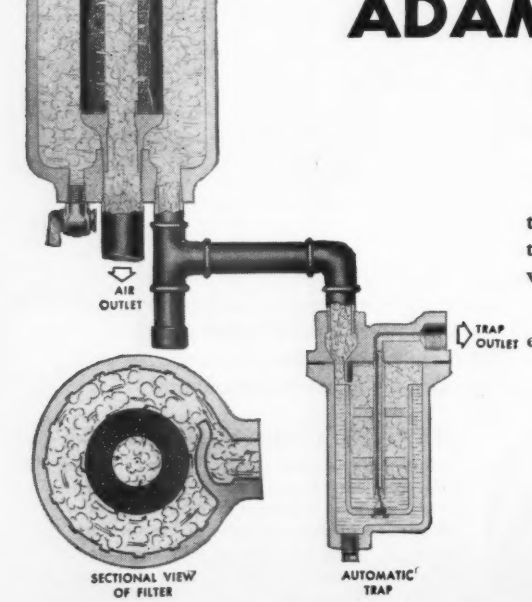

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